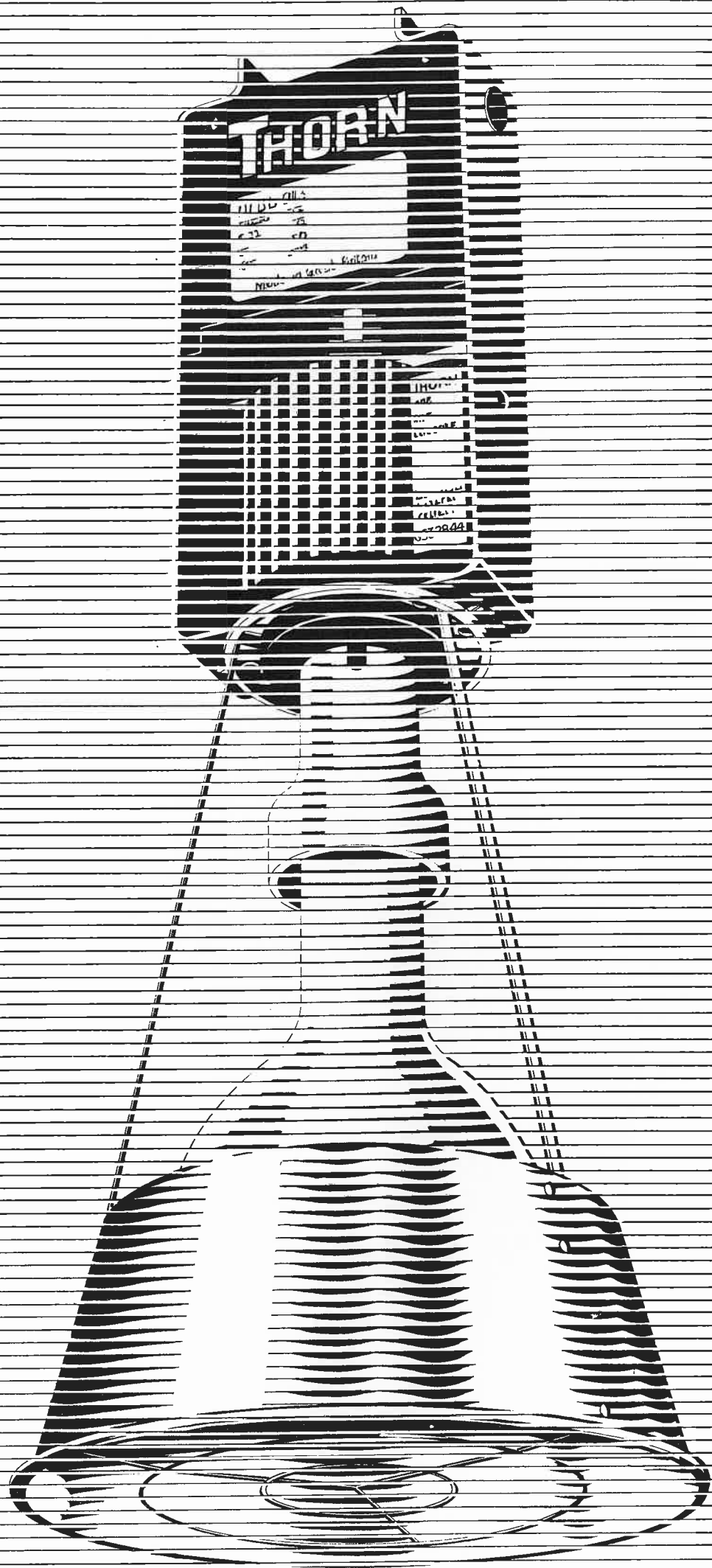


LIGHTING JOURNAL

Hipak—a design exercise
Decorative incandescent lamps
Kite-marks and approval marks

number eleven/autumn 1973 / published by THORN LIGHTING LIMITED





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2-5 French, German, Spanish, Italian digests

- 6** Hipak – a design exercise *by* P G Harding
- 10** Victoriana relighted *by* Colin Horsfield
- 14** Electronic dimming systems *by* B Massey and I J Bramson
- 18** Some recent installations
- 22** Outdoor Lighting Awards 1975
- 23** Lighting a London underpass
- 25** Decorative incandescent lamps *by* G E Coxon
- 29** Kite-marks and approval marks *by* R C Kember, L H Da Volls and J E Greenhill
- 32** Metal halide lamps for colour printing *by* A L Salway and E J G Beeson
- 36** Avonbank – a footnote

This journal attempts to reflect the technical activities of Thorn Lighting in the fields of lamp research and production, the design and manufacture of luminaires and in lighting practice. Such a picture cannot be presented in a single issue. Indeed, some issues, because they are written around a theme, may seem to be rather one-sided. Taken over the years, however, a fairly coherent portrait of the company should have emerged.

This issue, the eleventh of the series, looks at three main aspects of the company's work. First, it is concerned with the impact of the international outlook encouraged by our entry into the European Economic Community. Articles on the design of a range of industrial fittings for the world market, on international standardisation and illustrations of interesting installations abroad mark this theme.

Another side of the company's activities shown in this issue is the application of lamps and fittings, in which it plays a leading part. The articles describing the relighting of Whitworth Hall and the design of the lighting of the Wick Road Underpass in London, as well as short descriptions of other schemes and a glance at the results of work at Avonbank, Bristol, are of this nature.

Then comes the important aspect of lamp technology. It cannot be too much emphasised that all the progress made in lighting in the last hundred years is entirely due to advances in lamp-making techniques and to improvements in the light output, life and colour-rendering properties of lamps. In this category are the articles on decorative filament lamps and the new MBI lamps for colour printing and we also look at recent developments in electronic dimming techniques.

Next spring we hope to publish articles marking the Jubilee Year of the APLE and on some very interesting lamp developments as well as reporting progress in lighting and manufacturing techniques.

dans cette édition

6 HIPAK - UN EXERCICE DE "DESIGN" EN L'ÉCLAIRAGE P. G. Harding.

Les appareils pour éclairer les ateliers de grande hauteur avec des lampes à décharge à haute pression existent depuis un certain nombre d'années, comme la plupart des objets qui ont été mis au point petit à petit, ils tendent à être volumineux et souvent lourds et difficiles à installer. Les ingénieurs des Etudes de Thorn Lighting ont donc décidé de les reconsidérer et de voir comment on pourrait améliorer leur style. Ils entreprennent une étude comportant des consultations avec les parties intéressées dans le monde entier et ils définissent cinq critères de construction fondamentaux, à savoir un rendement optique élevé, une installation et un entretien rapides et faciles, un fonctionnement sûr, une construction robuste et le respect des normes nationales et internationales. Les ensembles qui résultent de cette étude offrent un certain nombre de caractéristiques exceptionnelles. On parvient au positionnement précis des lampes de 250 w et de 400 w dans un seul réflecteur grâce à l'emploi d'une entretoise. Ceci améliore aussi bien la répartition de la lumière que le rapport de sortie de lumière des ensembles. Les méthodes de câblage et de suspension furent simplifiées et le poids, par rapport à celui de types antérieurs, fut largement réduit. Les composants sensibles à la chaleur furent isolés du ballast, ce qui permet un bon fonctionnement dans les températures ambiantes allant jusqu'à 40 °C. Le montage est protégé contre la corrosion et est conforme aux critères d'essais thermiques de la norme BS 4533. Il a été essayé et homologué conformément au Code de Protection International, norme IP22, et il a remporté le trophée de la "gute Industrieform 73" à la Foire Commerciale de Hanovre.

10 NOUVEL ÉCLAIRAGE POUR UN BÂTIMENT DE L'ÉPOQUE VICTORIENNE. Colin Horsfield.

La maison Whitworth, l'un des plus anciens bâtiments de l'université de Manchester, est une structure gothique victorienne dessinée par Waterhouse, mieux connue pour avoir conçu l'Hôtel de Ville de Manchester. Comme tant de bâtiments de son époque, celui-ci pose un problème d'éclairage difficile à résoudre, d'un part à cause des limitations imposées par le style de son architecture et d'autre part à cause de la diversité des fonctions qu'il est appelé à remplir.

Éclairé initialement au gaz, il fut équipé vers la fin des années 1930 de dix grands chandeliers octogonaux abritant chacun une lampe de 300 w et trois lampes de 100 w derrière des panneaux de verre opale teinté et suspendus par les poutres de la toiture. L'éclairage obtenu était inadéquat pour la plupart des fonctions et, lorsqu'on utilisait ce bâtiment pour des examens, il fallait compléter ces chandeliers par des tubes fluorescents suspendus à des tirants. Lorsqu'on décida de nettoyer le bâtiment et d'en améliorer l'éclairage, une équipe de l'université, dirigée par le Dr. James Bell, travailla en étroite collaboration avec les ingénieurs de Thorn Lighting et établit un plan selon lequel l'éclairage provenait de divers types de projecteurs montés parmi les poutres de la toiture compliquée en bois. Dix anciens lustres à gaz furent suspendus aux poutres principales pour produire l'éclat et l'ambiance voulus.

L'éclairage principal de "travail" destiné à être utilisé pendant les examens et pour les fonctions comparables est assuré par six lampes tungstène-halogènes de 1.500 w montées dans des réflecteurs OHD directement au-dessous du bord de toiture, tandis que l'éclairage général, surtout indirect, est assuré par des lampes PAR 56 de 530 w montées par paires juste au-dessus des poutres et des réflecteurs Sunflood de 500 w dirigés sur les murs et le plafond à partir de points situés immédiatement au-dessous; en les montant ainsi, on put obtenir une réduction des ombres sur le plafond et une amélioration de l'effet de mise en valeur des poutres elles-mêmes.

Les embrasures de fenêtres contenant des portraits suspendus sur des lambris de chêne comportent un éclairage spécial provenant de tubes fluorescents blanc chaud de 60 w montés sur des ensembles Arrowstim avec des chicanes métalliques peintes pour s'harmoniser aux lambris.

Chacun des dix lustres à gaz en fer forgé qui ont remplacé les lustres octogonaux est équipé de dix-huit lampes claires de 24 w 12 w montées approximativement aux points occupés par les anciennes buses à gaz. Elles sont utilisées légèrement au-dessous de leur capacité pour leur assurer une longue utile. Un projecteur PAR 38 de 150 w est monté dans la base de chaque chandelier pour projeter sa lumière vers le haut et faire ressortir les dorures sur les moulures.

On peut voir d'après les photographies que cet ensemble est une réussite. C'est un exemple classique de ce que l'on peut réaliser lorsque l'architecte et le technicien de l'éclairage collaborent dès le lancement des études.

14 SYSTEMS GRADATEURS ELECTRONIQUES. B. Massy, and I. J. Bramson.

Les circuits gradateurs furent utilisés pour la première fois sur les systèmes d'éclairage électrique nouveaux au théâtre lorsqu'il devint nécessaire de trouver un remplacement pour la réduction de la lumière du gaz. On utilisa des rhéostats grossiers bobinés et des "gradateurs à eau" pour les systèmes à courant continu dont on disposait alors. Au début des années 1930, les alimentations en courant alternatif permirent une amélioration du contrôle, mais les transformateurs variables et les électro-aimants utilisés étaient encore volumineux et l'introduction du thyatron, juste avant la guerre ouvrit la porte aux systèmes de commande électroniques. Depuis lors, les dispositifs à l'état solide utilisant les Thyristors et les Triacs ont conduit à la réalisation d'appareils d'encorement incroyablement faible avec des pertes de puissance négligeables. Bien que les installations les plus grandes soient encore confinées à la scène et aux studios de télévision, les méthodes de gradation actuelles trouvent des applications partout où l'on utilise un éclairage

artificiel et peuvent être appliquées aux lampes à filaments de tungstène aussi bien qu'aux lampes fluorescentes.

Des ensembles de commande de petites dimensions, avec des batteries de deux ou plus de deux atténuateurs s'offrent aux utilisateurs pour les scènes de théâtre amateur et une commande automatique aussi bien que manuelle est possible dans un certain nombre de cas. L'éclairage peut être intensifié ou atténué progressivement, peut être pulsé en synchronisation avec la musique ou peut changer de couleur suivant les besoins et il existe des "systèmes de mémoires" qui permettent de stocker des systèmes d'éclairage complets dans un "cerveau électronique", systèmes qui peuvent être mis en circuit lorsqu'on en a besoin. Les théâtres plus grands et les studios de télévision utilisent des systèmes comme les systèmes Q-Master et Q-File de Thorn qui accumulent jusqu'à 200 "mémoires" dans une petite armoire.

La gradation électronique est maintenant appliquée à une grande variété d'installations d'éclairage, des galeries d'art aux hôpitaux et des magasins aux tunnels et aux passages souterrains. On peut facilement obtenir des conseils quant à son emploi après d'organisations comme la division d'éclairage théâtral de Thorn.

23 L'ÉCLAIRAGE DU SOUTERRAIN DE WICK ROAD À LONDRES.

Ce souterrain récemment achevé consistait en un tunnel courbe à trois voies de 152 m de long, deux corniches fluorescentes continues produisant un éclairage moyen de 250 lux le jour et de 56 lux la nuit lorsque la moitié des lampes sont éteintes.

Des lampes Thorn KolorSON (SON/T) montées dans des réflecteurs de construction spéciale élèvent l'éclairage à l'entrée à 3000 lux pour les jours ensoleillés, le réduisant au niveau de base en deux phases de 2000 lux et 1100 lux. Les jours où l'éclairage extérieur est inférieur à 2000 lux, la moitié des lampes de l'entrée sont éteintes par l'intermédiaire d'une cellule photo-électrique.

Dans la première section de 50 m du tunnel, des encastrements transversaux abritant chacun deux lampes SON/T de 400 w dans des réflecteurs paraboliques ont été formés dans le béton avec des entrées de 1,5 m. Ces ensembles sont inclinés vers l'entrée pour produire un éclairage total de 3.000 lux au niveau de la route; dans la seconde section de 50 m, l'espacement est porté à 3 m, ce qui réduit l'éclairage à 2.000 lux et, dans la troisième section, on utilise des lampes SON de 250 w pour abaisser l'éclairage à 1.100 lux. Les montages ont été étudiés par les techniciens de la division des services électriques du département de l'architecture et du génie civil du Conseil Municipal du Grand Londres, réalisés par Thorn Lighting Ltd et installés par Green and Silleyweir Ltd.

25 L'ÉTUDE DES LAMPES POUR FONCTIONS DÉCORATIVES. DR. G. E. COXON.

Les "lampes de fantaisie" conçues plus pour leur effet décoratif que comme source de lumière ont fait leur apparition quelques années seulement après les lampes originales à filament de carbone de Swan & Edison. Certaines de ces lampes avaient des ampoules colorées ou de forme inhabituelle, ou d'un fini spécial, d'autres imitaient des dispositifs d'éclairage du passé, comme, par exemple, les bougies.

Lorsqu'on commença à utiliser les filaments métalliques, ces types de lampes spéciales persistèrent et on leur ajouta les lampes à filaments tubulaires qui firent leur apparition entre les deux guerres. Ces lampes sont encore utilisées pour éclairer les comptoirs de présentation des bijoux.

Récemment l'intérêt manifesté à l'égard des lampes en tant qu'objets décoratifs a connu un renouveau et ceci a conduit à des méthodes d'étude nouvelles reposant sur les techniques de la production en série. Ceci imposa certaines restrictions à la fabrication, particulièrement parce que ces méthodes nécessitent le recours à des laques colorées appliquées sur la surface de verre au lieu du soufflage des ampoules en verre coloré.

L'argenterie intérieure aussi bien des lampes à réflecteurs de verre obtenues par soufflage que des types à calotte argentée devient de plus en plus populaire et le revêtement intérieur avec la silice est également courant. Les vernis colorés doivent être cuits sur le verre et un contrôle étroit de la température en fabrication est essentiel. Ces revêtements peuvent également affecter la température de fonctionnement de la lampe. On trouve un récent développement dans l'emploi de filtres dichroïques pour produire des écrans de couleur et des "miroirs froids".

La tendance à de nouvelles formes et couleurs de lampes décoratives est un écho des idées du passé, mais l'emploi de techniques et de matières nouvelles montre que ces idées sont encore bien vivantes même après près de 100 ans de progrès dans le domaine de l'éclairage.

29 LABELS EN CERF-VOLANT ET KEMER D'HOMOLOGATION. R. C. KEMBER, J. E. Greenhill et L. H. Da Voils.

Les labels d'homologation gouvernementaux sont largement utilisés sur le continent européen. Ils protègent le client contre les produits non satisfaisants ou dangereux et assurent que les produits offerts atteignent une norme reconnue. Des essais de cette nature ont été effectués depuis longtemps au Royaume Uni sur une base volontaire et l'on utilise actuellement un certain nombre de labels d'homologation. En Février de cette année, cependant, le Conseil de la CEE a publié une brochure contenant d'importantes directives connues généralement sous le nom de "Directives

concernant la Basse Tension" qui a été étudiée pour harmoniser les règlements de sécurité de l'éclairage dans les pays membres et pour faciliter ainsi le commerce entre ces pays. La directive consiste en un préambule et quatorze articles, dont le troisième demande que les pays membres agissent à cet égard dans les dix-huit mois de sa publication.

Une nouvelle norme britannique pour les accessoires d'éclairage, la norme BS 4533 a été publiée récemment et, en même temps, la Fédération de l'Industrie de l'Éclairage et l'Institut Britannique de Normalisation ont produit un système de labels à "Cerf-Volant". Ceci garantit l'homologation non seulement par l'essai des dispositifs d'éclairage individuels, mais encore en demandant que les moyens d'essai des constructeurs soient aménagés conformément à la norme du BSI, avec des inspections périodiques de leurs ateliers.

On se penche actuellement sur la nécessité de classer les surfaces de montage et il est vraisemblable que ceci sera effectué sur une base internationale. Ces surfaces peuvent être divisées en trois groupes, les surfaces incombustibles, les surfaces normalement inflammables et les surfaces facilement inflammables. Les accessoires d'éclairage ne doivent pas être montés sur ces dernières.

En Allemagne, un développement récent se préoccupe du risque de surchauffe d'un élément résistant dans un dispositif d'éclairage vers la fin de sa durée utile, risque qui pourrait entraîner la mise à feu de la surface sur laquelle le dispositif d'éclairage est monté. La solution allemande consiste à espacer cet élément du dispositif d'éclairage et ce dernier de la surface de montage. Les dispositifs d'éclairage ainsi conçus peuvent porter le label "F", la lettre "F" majuscule enfermée dans un triangle inversé. Les techniciens américains utilisent des coupe-circuits thermiques qui interviennent lorsque la température du mécanisme de commande atteint un niveau dangereux.

L'harmonisation des normes nationales de sécurité conduisant à une norme européenne complètement unifiée et à un seul label européen est bien avancé et il convient d'espérer que ceci conduira à l'établissement de normes mondiales. Le Royaume Uni a montré le chemin pour l'adoption de normes voisines et nous avons beaucoup à offrir à nos nouveaux partenaires dans le Marché Commun.

32 LAMPES AUX IODURES METALLIQUES POUR LES ARTS GRAPHIQUES. A. L. SALWAY & E. J. G. BEESON.

La préparation des plaques pour les arts graphiques est une activité commerciale importante. Il s'agit d'un processus photographique qui dépend de l'emploi d'une source de lumière riche dans la section ultra-violet du spectre. Pendant de nombreuses années, on a utilisé des lampes à arc au carbone, mais celles-ci ont été remplacées par d'autres sources, en particulier des arcs au Xénon pulvés. On a utilisé des lampes fluorescentes à ultraviolets, mais la nécessité d'utiliser plusieurs tubes pour obtenir la production de lumière requise a conduit à l'inconvénient de "undercutting", inconvénient que l'on ne rencontre pas lorsqu'on emploie une source ponctuelle.

Le lancement récent des lampes à décharge à iodures métalliques a conduit à l'emploi de sources linéaires de 1200 w dans un bon nombre de grandes machines d'imprimerie. En particulier, cette lampe a été standardisée pour être utilisée par Agfa Gevaert sur son système "Gevaprof". Toutefois, la lampe MBIL de 1200 w est trop grosse pour le petit imprimeur et présente quelques inconvénients techniques.

On a maintenant mis au point une lampe MBIL de 400 w scellée dans une enveloppe PAR 64 qui offre un certain nombre d'avantages. Le faisceau préfocalisé avec précision offre un rayonnement raisonnablement uniforme sur une surface rectangulaire de la dimension moyenne d'un petit châssis d'imprimerie et l'on peut aisément utiliser cette lampe à la place de la lampe à arc au carbone si on la monte dans un appareil étudié spécialement et comportant un obturateur à commande magnétique qui abrite le mécanisme de commande et le dispositif de mise en marche. Cette production des ultra-violets pour les méthodes d'imprimerie indique l'intérêt croissant manifesté à l'égard des sources de rayons ultra-violet, intérêt qui a attiré l'attention des laboratoires de recherche et de développement de Thorn.

36 AVONBANK - L'EXPERIENCE D'UNE ANNEE.

(Lighting Design and Technology, Vol. 5, No. 2 1973). L'environnement contrôlé à Avonbank, siège administratif de l'Electricity du Sud-Ouest à Bristol, a été décrit dans le No. 7 de *Lighting Journal*. Depuis lors, on a pu acquiescer une année d'après l'emploi de cet ensemble administratif et un rapport décrivant les résultats obtenus a été présenté au cours d'une réunion commune de l'IES et de la Building Services Engineering Society.

L'un des points les plus intéressants résultant de cette étude réside dans la réaction de ceux qui travaillent dans ces bureaux dans des conditions nouvelles. On leur demanda de remplir un questionnaire avant de quitter leurs anciens bureaux pour se rendre à Avonbank et on fit de même quelque quatre mois après qu'ils eussent commencé d'y travailler. Les réponses aux questions posées sont représentées sous forme graphique. Ces documents sont reproduits avec l'aimable autorisation des auteurs du rapport, M. Mark Wood-Robinson et M. Ian Chichon, et de l'IES qui les a déjà présentés dans ses compte-rendus.

in diese Ausgabe

8 HIPAK - EINE FORMGEBUNGSUNTERSUCHUNG. P. G. Harding.

Hochbuchtige Leuchtkörper, die Hochdruck-Entladungslampen enthalten, sind schon seit einer Anzahl von Jahren bekannt. Wie die meisten Dinge, die Stückweise entwickelt werden, so waren auch diese Leuchtkörper unhandlich und oft schwer zu installieren. Die Entwicklungsingenieure von Thorn Lighting entschlossen sich daher, das Problem neu anzugehen und zu untersuchen, wie die Gestaltung dieser Teile verbessert werden kann. Im Verlaufe der Durchführbarkeitsstudie wurden interessierte Parteien in der ganzen Welt befragt, und als Folge davon wurden fünf grundlegende Konstruktionsforderungen festgelegt, nämlich: hohe optische Wirksamkeit, einfache und schnelle Installation und Wartung, Zuverlässigkeit im Betrieb, robuste Bauweise und Erfüllung der nationalen und internationalen Normvorschriften. Die Leuchtkörper, die als Resultat dieser Untersuchungen hergestellt wurden, weisen einige ungewöhnliche Merkmale auf. Der präzise Einbau der 250 W und 400 W Lampen in einen gemeinsamen Reflektor wurde durch Verwendung eines Distanzstücks ermöglicht. Hierdurch wurde sowohl die Lichtstreuung als auch der Leuchtenwirkungsgrad verbessert. Verdichtung und Aufhängungsmethoden wurden vereinfacht. Das Gewicht ist im Vergleich mit früheren Ausführungen bedeutend geringer. Wärme empfindliche Bauteile werden von der Drossel isoliert, so daß die Lampen in einer Umgebungstemperatur von 40°C betrieben werden können. Der Leuchtkörper ist korrosionsfest und entspricht den thermischen Prüfverfahren von BS-4533. Er wurde nach dem International Protection Code, Standard IP22 getestet und als dieser Vorschrift entsprechend anerkannt. Auf der Hannovermesse erhielt er die Auszeichnung "gute Industrieform 73".

10 VICTORIANA IN NEUEM LICHT. Colin Horsfield.

Die Whitworth Halle, eines der ältesten Gebäude im Komplex der Universität von Manchester, ist ein viktorianischer Bau in gotischem Stil von Waterhouse, der besonders für den Bau des Manchester Rathauses berühmt ist. Wie bei so vielen anderen Bauten jener Zeit, so ergeben sich auch bei diesem erhebliche Beleuchtungsprobleme, teilweise wegen architektonisch bedingter Beschränkungen, teilweise weil der Bau für so verschiedene Zwecke benutzt wird. Die ursprüngliche Gasbeleuchtung wurde Ende der 30er Jahre durch zehn große achteckige Hängeleuchten mit je einer 300 W und drei 100 W Lampen hinter farbigen Mattglasfädelungen ersetzt. Die Leuchten wurden paarweise an den Stützbalken des Daches aufgehängt. Die Beleuchtung war aber für die meisten Zwecke ungenügend und wenn die Halle z.B. für Examinationszwecke benutzt wurde, so mußten zusätzliche Leuchtstoffröhren an den Stützbalken aufgehängt werden. Als man sich dazu entschloß, die Halle zu reinigen und die Beleuchtung zu verbessern, arbeitete ein Team von der Universität unter Führung von Dr. James Bell in enger Zusammenarbeit mit den Ingenieuren von Thorn Lighting und als Resultat wurde ein Schema ausgearbeitet, bei dem die Hauptbeleuchtung von verschiedenartigen Scheinwerfern ausging, die sich zwischen den Trägern des kunstvoll ausgearbeiteten Holzdaches angebracht wurden. Zehn antike Gaskronleuchten wurden an die Stützbalken aufgehängt, um "Glanz und Atmosphäre" zu verbreiten. Das Hauptlicht "erschleucht" für Examen und ähnlichen Funktionen ging von sechs 1000 W Wolfram-Halogenlampen aus, die in obenliegenden Reflektoren direkt unter dem Dachfirst angebracht waren, während die allgemeine - mesitens indirekte - Beleuchtung von 300 W PAR 56 Lampen abgegeben wurde, die etwas unterhalb der Stützbalken montiert waren, von einer 500 W "Sunfood"-Lampe, die von einer darunterliegenden Stelle aus Wände und Decke anstrahlte. Auf diese Weise wurde zu gleicher Zeit eine geringere Beschattung der Decke und eine bessere Hervorhebung der Balken erzielt. Fensteransparungen, in denen Porträts an Eichen-Tafelungen aufgehängt waren, erhalten eine besondere Beleuchtung von einer 50 W Leuchtstoffröhre, die ein warmes weißes Licht abgibt. Die Fassungen der Röhren sind "Arrowlim"-Leuchtkörper, deren metallische Schutzschirme mit einer zu Tafelung passenden Farbe angestrichen sind. Jeder der zehn schmiedeeisernen Gaskronleuchten, die anstelle der achteckigen Hängeleuchten getreten sind, ist mit achtzehn 24 V, 12 W klaren Schienlampen ausgerüstet und ungefähr an den gleichen Stellen angebracht, die früher von den Gasstrahlern eingenommen wurden. Der längeren Nutzungsdauer wegen sind sie etwas unterfahren. In den Sockel jeder der Hängeleuchten ist ein 150 W PAR 36 Flutlicht eingebaut, das sein Licht nach oben wirft und die vergoldeten Verzierungen hervorhebt. Aus den Fotografien ist ersichtlich, wie erfolgreich das Schema war. Es ist ein eklektisches Beispiel für die guten Resultate, die sich erzielen lassen, wenn Architekt und Beleuchtungsingenieur von Anfang an zusammen arbeiten.

14 ELEKTRONISCHE VERDUNKELUNGSSYSTEME. B. Massey, und I. J. Bramson.

Dimmerschaltungen wurden zuerst in den Pioniertagen der elektrischen Beleuchtungstechnik angewandt, als es notwendig war, im Theater eine Alternative zum Niederdrehen des Gases zu finden. Für die damals verfügbaren Gleichstromanlagen benutzte man schwerfällige, drahtumwickelte Rheostate und "Wasser-Dimmer". Anfangs der 30er Jahre ermöglichten die Wechselstromnetze eine bessere Steuerung, aber die Regelraster und sättigungsfähigen Drosseln waren immer noch sehr sperrig. Erst kurz vor den Kriegsausbruch wurde mit der Einführung der Thyatronröhre der Weg zu einer elektronischen Steuerung beschritten.

Seit jener Zeit haben Festkörperelemente mit "Thyristoren" und "Triacs" es möglich gemacht, unglaublich kompakte Geräte vernachlässigbaren Leistungsverlusten für diese Zwecke einzusetzen. Wenn auch der Einsatz von großen Anladungen zunächst noch auf die Bühne und das Fernsehstudio beschränkt ist, so finden doch die heutigen Methoden der Verdunklung überall dort Anwendung, wo künstliches Licht verwendet wird. Diese Methoden kommen sowohl für Wolframdraht- als auch für Leuchtstofflampen in Frage. Kleine Lichtsteuergeräte, mit Reihen von zwei oder mehr "Blenden" sind für die Amateurbühne verfügbar, und in manchen Fällen ist sowohl eine handbetätigte als auch eine automatische Steuerung möglich. Das Licht läßt sich wie benötigt auf- und abblenden, und es kann der Musik entsprechend pulsiert werden oder automatisch die Farbe wechseln, wenn dies angebracht ist. Außerdem sind Speichersysteme erhältlich, in denen ganze Beleuchtungssysteme in einem "elektronischen Hirn" gespeichert und zum richtigen Zeitpunkt eingeschaltet werden. Für große Bühnen und Fernsehstudios werden jetzt Systeme wie z.B. Thorn O-film und O-Master benutzt, die bis zu 200 Speicher in einem kleinen Schrank vereinen. Elektronische Verdunklung wird jetzt auch für viele verschiedene Beleuchtungseinrichtungen verwendet - von Gemalgalerien bis zu Hospitälern, von Läden bis zu Tunneln und Unterführungen. Organisationen wie die Thorn Theatre Lighting Division erteilen gern Informationen hierüber.

23 BELEUCHTUNG DER WICK ROAD UNTERFÜHRUNG IN LONDON.

Diese vor kurzem fertiggestellte Unterführung besteht aus einem 152 m langen dreibahnigen Kurventunnel. Zwei durchlaufende Leuchtstoffarmee erzeugen eine durchschnittliche Beleuchtungsstärke von 250 Lux am Tage und 56 Lux bei Nacht, wenn die Hälfte der Lampen erloschen ist. Thorn Koloson (SON/T) Lampen in speziell gestalteten Reflektoren verstärken die Beleuchtung am Eingang (an einem hellen Tag zu 3000 Lux). Die Abschwächung erfolgt in zwei Stufen von 2000 Lux und 1100 Lux auf Grundniveau. Am Tage, wenn die äußere Beleuchtungsstärke weniger als 20 000 Lux beträgt, wird die Hälfte der Lampen während der ersten Stufe durch ein fotoelektrisches Element gelöst. Im ersten, 50 m langen Abschnitt des Tunnels wurden im Beton im Abstand von 1,50 m schräge Rinnen geformt, in denen zwei 400 W SON/T Lampen in Parabolreflektoren angebracht sind. Sie sind dem Eingang zugewandt und erzeugen auf Straßenniveau eine gesamte Beleuchtungsstärke von 3000 Lux. Im zweiten 50 m Abschnitt ist der Abstand auf 3 m erweitert und die Beleuchtungsstärke auf 2000 Lux reduziert. Im dritten Abschnitt werden 250 W SON Lampen verwendet, die die Leuchtstärke auf 1100 Lux herabbringen. Die Leuchten wurden von Ingenieuren der Electrical Services Division des Department of Architecture and Civic Design des Greater London Council konstruiert, von Thorn Lighting Ltd. hergestellt und von Green and Silleyweir Ltd. installiert.

25 LAMPENDESIGN FÜR DEKORATIVE ZWECKE. Dr. G. E. Coxon.

Effektlampen, die hauptsächlich als Verzierung und erst in zweiter Linie als Lichtquelle dienen, traten innerhalb weniger Jahre, nachdem Swan und Edison Original-Kohlefadenlampen auf den Markt kamen, in Erscheinung. Einige hatten farbige oder ungewöhnlich geformte Birnen, andere imitierten frühere Beleuchtungsmethoden wie z.B. Kerzen. Als man begann, Metallfäden zu benutzen, behaupteten sich diese besonderen Arten von Lampen und dazu kamen noch röhrenförmige Fadenlampen, die zwischen den beiden Welkgruppen auf dem Markt erschienen. Diese Lampen werden immer noch für Juwelierinnen benutzt. Seit einiger Zeit wird erneut Interesse für Lampen als Zeitgenstände gezeigt, mit dem Resultat, daß das Designproblem insofern neu angegangen wurde, als man sich jetzt auf die Methoden der Massenproduktion stützte. Dabei ergaben sich für die Fabrikation einige Einschränkungen, insbesondere war es nunmehr notwendig, Lackfarben auf die Glasoberflächen aufzutragen anstatt die Birnen aus farbigem Glas zu blasen. Die Nachfrage nach innerer Verbläserung - sowohl von Reflektorlampen aus gefärbtem Glas als auch die Arten der Kroneverbläserung - wird ständig größer, und auch die Innenbeschichtung mit Kieseloxide ist populär. Lackfarben müssen auf das Glas aufgebracht werden und bei diesem Herstellungsprozeß ist eine strenge Temperaturkontrolle unerlässlich. Diese Art von Überzug kann auch die Betriebstemperatur der Lampe beeinflussen. Eine neuere Entwicklung ist die Verwendung von Zwillerablenitern für Farbscheiben und "Kaltspiegel". Der Trend zu den neuen Formen und Farben der Zielampnen widerspiegelt die Ideen der Vergangenheit. Die Verwendung von neuen Materialien und Methoden zeigen, daß selbst nach 100 Jahren Fortschritt in der Beleuchtungstechnik die Ideen der Vergangenheit im Geiste des Publikums immer noch lebendig sind.

29 DRACHEN-MARKEN UND GUTBEFUNDZEICHEN. R. C. Kember, J. E. Greenhill und L. H. De Volls.

Behördliche Gutbefundzeichen werden auf dem europäischen Kontinent viel verwendet. Sie schützen den Kunden gegen unbefriedigende oder unsichere Erzeugnisse und sorgen dafür, daß die angebotenen Waren einen anerkannten Gütegrad aufweisen.

Derartige Prüfungen werden in Großbritannien schon seit langem auf einer freiwilligen Grundlage ausgeführt. Zur Zeit gibt es eine ganze Reihe von Gutbefundzeichen. Im Februar dieses Jahres erließ der EWG-Rat eine wichtige Direktive, die allgemein unter dem Namen Niederspannungsdirektive bekannt ist und mit der bezweckt wird, die Sicherheitsregulierungen in den angeschlossenen Ländern zu harmonisieren, um dadurch den Handel zwischen den Ländern zu erleichtern. Die Direktive besteht aus einer Einleitung und 14 Bestimmungen, von denen die dreizehnte besagt, daß die Mitgliedsländer innerhalb von 18 Monaten ab Erlass der Bestimmung die bezüglichen Schritte unternehmen müssen. Vor kurzem wurde eine neue britische Normvorschrift für Beleuchtungskörper - die Vorschrift BS 4533 - erlassen und gleichzeitig führten die Lighting Industry Federation und die British Standards Institution eine "Drachen"-Markierung ein. Die Marke bedeutet nicht nur, daß der betreffende Artikel durch Testen der einzelnen Leuchten gutbefunden wurde, sondern auch, daß die Herstellerfirmen ihre Prüfeinrichtungen auf dem von BSI verlangten Standard halten müssen und daß ihre Fabrik regelmäßig inspiziert wird. Die Klassifizierung von Befestigungsflächen ist in Aussicht genommen und wird wahrscheinlich auf einer internationalen Basis erfolgen. Die Befestigungsflächen werden wahrscheinlich in drei Gruppen eingeteilt: unverbrennbare, normal brennbare und leicht brennbare. Beleuchtungskörper sollten nicht an Befestigungsflächen der letzteren Kategorie montiert werden. Eine kürzliche Entwicklung in Deutschland befaßt sich mit der Überhitzung des Vorwiderstands in einer Leuchte am Ende der Nutzdauer sowie mit der Gefahr, daß die Fläche, an welcher die Leuchte befestigt ist, Feuer fangen kann. Die deutsche Lösung des Problems besteht darin, den Vorwiderstand in einem Abstand von der Leuchte, und die Leuchte in einem Abstand von der Befestigungsfläche zu halten. Solche art konstruierte Leuchten erhalten die "F"-Marke - ein großes F, eingeschlossen in einem umgekehrten Dreieck. Amerikanische Ingenieure verwenden Ausschalter, die in Funktion treten, sobald die Temperatur des Kontrollgitters einen gefährlich hohen Stand erreicht. Die Bemühungen, nationale Sicherheitsnormen in Übereinstimmung zu bringen, so daß eine vollkommen einheitliche europäische Norm geschaffen wird, sind weit fortgeschritten und man hofft, daß dies zur Schaffung von weltweit gültigen Normen führen wird. Was die Aufzierung freiwilliger Normen anbelangt, so ist Großbritannien führend, und wir haben unseren Partnern in der EWG diesbezüglich viel zu bieten.

32 HALAGONDLAMPEN FÜR DAS GRAPHISCHE GEWERBE. A. L. Salway, und E. J. G. Beeson.

Die Kiesscheherstellung für gas graphische Gewerbe ist ein großes Geschäft. Es handelt sich hier um ein fotografisches Verfahren, bei dem eine Lichtquelle mittels ultraviolettem Spektrum benutzt werden muß. Viele Jahre lang wurden dazu Kohlebogenlampen benutzt, die aber jetzt durch andere Lichtquellen, besonders durch pulsierte Xenonbogen, ersetzt werden. UV emittierende Leuchtstoffröhren werden verwendet, aber die Notwendigkeit, mehrere Röhren zu benutzen, um auf die erforderliche Lichtstärke zu kommen, hat den Nachteil des "Unterscheidens", der bei Verwendung einer Punktquelle nicht in Erscheinung tritt. Kürzlich eingeführte Halogon-Entladungslampen haben dazu geführt, daß in einigen großen Druckereien 1200 W Linearquellen benutzt werden, insbesondere werden diese Lampen zur Verwendung für das "Gevaproof"-System von Agfa Gevaert standardisiert. Die 1200 W MBIL Lampe ist jedoch für kleinere Druckereibetriebe zu groß und hat einige technische Nachteile. Jetzt wurde eine in eine PAR 64 Hülle eingeschmolzene 400 W MBIL Lampe entwickelt, die verschiedene Vorteile hat. Der genau voreingestellte Strahl gibt über eine rechteckige Fläche von der durchschnittlichen Größe eines Kopierrahmens eine einigermaßen gleichmäßige Strahlung. Diese Lampe läßt sich leicht anstelle eines Kohlebogens einsetzen, wenn sie in einem speziell konstruierten Leuchtkörper montiert ist, der mit magnetisch betätigter Blende versehen ist und Steuer- und Statortriebe enthält. Diese Anwendung von UV für Druckverfahren ist bezeichnend für das wachsende Interesse an UV-Quellen für weitere Einsatzgebiete, ein Umstand, dem in den Forschungs- und Entwicklungsabteilungen von Thorn die gebührende Aufmerksamkeit geschenkt wird.

36 AVONBANK - EIN JAHR ERFARUNG.

(Lighting Design and Technology, Vol. 5, No. 2 1973). Die geregelte Umwelt in Avonbank - die Büros von South Western Electricity Boards in Bristol - wurden in Ausgabe 7 von *Lighting Journal* beschrieben. Seitdem ist über ein Jahr vergangen und ein auf einer gemeinsamen Sitzung von IES und der Building Services Engineering Society gehaltenen Vortrag beschäftigt sich mit den Ergebnissen. Einer der interessantesten Punkte, die sich aus dieser Studie ergeben, sind die Reaktionen der Leute, die in den Büros unter den neuen Umständen arbeiten. Dieses Personal wurde aufgefordert, einen Fragebogen auszufüllen, bevor es von herkömmlichen Büros nach Avonbank kam, und dann wieder, nachdem es 4 Monate lang dort gearbeitet hatte. Die Antworten werden in graphischer Form gezeigt. Dieses Material wird mit Genehmigung der Verfasser - Mr. M. Wood-Robinson und Mr. Ian Crichton - sowie der IES, in dessen "Transactions" es bereits veröffentlicht wurde, wiedergegeben.

6 HIPAK—UN EJERCICIO DE DISEÑO P. H. Harding.

Las instalaciones para naves altas a base de lámparas de descarga de alta presión han estado en uso desde hace años; como la mayoría de cosas que han sido desarrolladas trozo por trozo tienden a ser toscas y a menudo pesadas y difíciles de instalar. Por tanto, los Técnicos de Desarrollo del Alumbrado de la Thorn han decidido mirárselas con nuevos ojos y ver cómo puede mejorarse su diseño.

Un estudio sobre lo factible del proyecto, para el que se consultó con partes interesadas del mundo entero, estableció cinco requisitos fundamentales del punto de vista del diseño, a saber: alta eficiencia óptica; instalación y cuidado simples y rápidos; operación sin fallos; construcción robusta y conformidad con los estándares nacionales e internacionales.

Los aparatos fruto de este estudio tienen varios rasgos fuera de lo corriente. Se ha logrado la colocación exacta de lámparas tanto de 250w como de 400w en un solo reflector mediante el uso de un espaciador. Esto ha mejorado a la vez la distribución de la luz y la proporción de la cantidad de luz producida por estas instalaciones. Se ha simplificado la conexión de hilos y los métodos de suspensión y se ha reducido considerablemente el peso, en comparación con el de los tipos anteriores. Se han aislado de la bobina los componentes sensibles al calor permitiendo así el funcionamiento en temperaturas ambientes tan altas como 40°C. La instalación está hecha a prueba de corrosión y en conformidad con las estipulaciones relativas a pruebas térmicas del BS 4533. Ha sido probada y aprobada de acuerdo con el Código de Protección Internacional, el Standard IP22 y ha ganado el premio "Gute Industrieform 73" en la Feria Comercial de Hannover.

10 ERA VICTORIANA BAJO NUEVA LUZ Colin Horatfield

Whitworth Hall, uno de los edificios más viejos de la Universidad de Manchester, es una estructura de gótico victoriano diseñada por Waterhouse, más famoso como arquitecto de casa Municipal de Manchester. Como ocurre con tantos edificios del mismo periodo, su iluminación presenta un problema difícil, debido en parte a las limitaciones que impone su estilo arquitectónico y en parte a la diversidad de usos que cubre.

Alumbrado originalmente con gas, fue provisto en los últimos años 30 de diez grandes lustros octogonales, que contenían cada uno una lámpara de 300w y tres lámparas de 100w detrás de unos paneles de vidrio opalino de color y que colgaban de dos en dos de las vigas del techo. La luz que daban era insuficiente para la mayoría de usos y cuando se utilizaba la sala para exámenes era necesario suplementarlos con tubos fluorescentes colgados de las barras de unión. Cuando se decidió limpiar Whitworth Hall y mejorar su alumbrado, un equipo de la Universidad, encabezado por el Dr. James Bell, trabajó en estrecha colaboración con los técnicos de Thorn Lighting y produjo un proyecto donde la iluminación principal procedía de varios tipos de proyectores montados entre las vigas del elaborado techo de madera. Se colgaron de las vigas diez arañas de gas antiguas de hierro forjado para que relucieran y crearan "atmósfera".

La luz principal "de trabajo" que se usa durante los exámenes y funciones semejantes proviene de seis lámparas cuatrío-cada de 1.000w montadas en reflectores OHD directamente debajo de la punta del tejado, mientras que la iluminación general, principalmente indirecta, proviene de unas lámparas PAR 56 de 300w montadas en paneles justo por encima de las vigas y de unos potentes focos de 500w dirigidos hacia las paredes y el techo desde inmediatamente debajo de ellas; montándolos en esta posición se redujo el oscurecimiento del techo y se mejoró el modelado de las vigas mismas. Los alfileres de las ventanas, que contienen retratos colgados contra paneles de roble, cuentan con una iluminación especial procedente de unos tubos fluorescentes de 50w de un blanco cálido con monturas Arrowsmith provistas de pantallas metálicas pintadas imitando los paneles.

Cada una de las diez arañas de gas de hierro forjado que sustituyeron los lustros octogonales está equipada con dieciocho lámparas colectoras de 24v 12w montadas aproximadamente en el lugar ocupado anteriormente por los chorros de gas. Se usan con potencia ligeramente reducida para asegurar una larga vida. En la base de cada brazo se halla montado un foco PAR 38 de 150w que dirige su luz hacia arriba haciendo brillar el dorado de las volutas de metal. Puede apreciarse por las fotografías que el proyecto ha sido un éxito. Constituye un ejemplo clásico de lo que se puede lograr cuando el arquitecto y el técnico en alumbrado colaboran desde el principio de un proyecto.

14 SISTEMAS ELECTRONICOS DE REDUCCION DE LUZ. B. Massey y I. J. Bramson.

Los circuitos para reducir la intensidad de la luz se empezaron a usar en los primeros sistemas eléctricos de alumbrado para el teatro, donde era necesario encontrar una alternativa a bajar el gas. Se utilizaron toscos reostatos de hilos enrollados y "reductores acústicos" para los sistemas de CC entonces en uso. En los primeros años 30 los sistemas de CA permitieron un mayor grado de control, pero los transformadores variables y los reactores saturables utilizados eran todavía engorrosos y la introducción de la válvula de "tiratron" justo antes de la guerra abrió el paso a los sistemas electrónicos de control.

Desde entonces partiendo de aparatos de estado sólido que utilizan "Tiristores" y "Triacs" se ha llegado a unas instalaciones increíblemente compactas con una pérdida insignificante de potencia.

Aunque las instalaciones más grandes todavía se hallan confinadas en los teatros y los estudios de televisión, los métodos actuales de reducción de luz pueden aplicarse dondequiera que se utiliza una iluminación artificial, y se pueden aplicar tanto a los filamentos de tungsteno como a las lámparas fluorescentes.

Existen pequeños sistemas de control, con juegos dos o más "apagadores" para teatros de aficionados y en ciertos casos tanto se pueden controlar automáticamente como manualmente. Las luces pueden intensificarse o bajarse, pueden ser pulsadas al compás de la música o cambiar automáticamente de color según se desee y existen "sistemas de memoria" en los que pueden archivarse en un "cerebro electrónico" sistemas enteros de iluminación y que se pueden poner en circuito cuando se quiere. Los teatros más grandes y los estudios de televisión utilizan sistemas tales como el Archivio-Q y la Matriz-Q de la Thorn en los que se pueden archivar un máximo de 200 "memorias" en un pequeño mueble.

Los sistemas electrónicos de reducción de luz se usan ahora en una gran variedad de instalaciones luminosas, desde galerías de arte a hospitales y desde tiendas a túneles y pasos subterráneos. Organizaciones como la Sección de Teatro de Thorn Lighting se complacen en asesorar sobre su uso.

23 LA ILUMINACIÓN DEL PASO SUBTERRÁNEO DE WICK ROAD EN LONDRES

Este paso subterráneo recién acabado consiste en un túnel curvado de tres carriles de 152m de largo; dos cornisas fluorescentes continuas producen en promedio un alumbrado de 250 lux de día y 56 lux de noche, cuando la mitad de las lámparas están apagadas. Lámparas Thorn KolorSON (SON/T) montadas en reflectores diseñados especialmente aumentan la iluminación a la entrada del túnel hasta 3.000 lux en un día claro, reduciéndola en dos etapas de 2.000 lux y 1.100 lux hasta el nivel básico. En días en que la luz exterior no llega a los 20.000 lux la mitad de las lámparas de la etapa inicial se apagan por medio de una célula fotoeléctrica. En la primera sección de 50m del túnel unas artesas transversales que contienen cada una dos lámparas SON/T de 400w en reflectores parabólicos han sido formadas en el hormigón a una distancia, de centro a centro, de 1,5m. Están orientadas hacia la entrada y producen una iluminación total de 3.000 lux al nivel de la calzada; en la segunda sección de 50m la separación aumenta a 3m, lo que reduce la iluminación a 2.000 lux y en la tercera se han utilizado lámparas SON de 250w, reduciéndola a 1.100 lux. Diseñaron las instalaciones los técnicos de la Sección de Servicios Eléctricos del Departamento de Arquitectura y Diseño Municipal del Greater London Council, las hizo la Thorn Lighting Ltd. y las instaló Green and Silleywell Ltd.

25 EL DISEÑO DE LAMPARAS DECORATIVAS Dr G. E. Coxon.

Las "lámparas de fantasía" diseñadas más por su efecto decorativo que como fuentes de luz aparecieron poco después de las lámparas originales de filamento de carbono de Swan y Edison. Algunas tenían bombillas de colores o de formas o acabados fuera de lo corriente, otras imitaban medios de iluminación anteriores como las velas.

Cuando empezaron a usarse los filamentos de metal, todavía persistieron estos tipos especiales de lámpara y a éstas vinieron a unirse las lámparas tubulares de filamento que aparecieron entre las dos guerras mundiales. Estas lámparas siguen utilizándose para iluminar los escaparates de los joyeros.

Ultimamente se ha vuelto a despertar el interés en las lámparas como objetos decorativos, lo que ha originado un modo nuevo de enfocar su diseño basado en las técnicas de la producción en masa. Esto ha impuesto algunas restricciones a los métodos de fabricación; en particular, se han tenido que usar laca de colores aplicadas a la superficie del cristal en lugar de soplar las bombillas en cristal de colores. El plateado interno, tanto de las lámparas tubulares de vidrio soplado como de los tipos con corona plateada, se vuelve cada vez más popular y también es corriente el recubrimiento interno con silice. Las laca de colores tienen que cocerse en el cristal y es esencial el control riguroso de la temperatura durante la fabricación. Estas capas también pueden afectar la temperatura de operación de la lámpara. Una novedad reciente es el uso de los filtros dicroicos para proporcionar pantallas de color y "espejos fríos". La tendencia a las nuevas formas y colores decorativos para lámparas recuerda las ideas del pasado, pero el uso de nuevos materiales y técnicas muestra que estas ideas todavía perduran aun después de casi 100 años de progreso en cuestión de iluminación.

29 "KITE MARKS" Y MARCAS DE APROBACIÓN R. C. Kember, C. Eng. MIEE, Millum ES, J. E. Greenhill, y L. H. Da Volla.

Las marcas de aprobación del Gobierno Británico se usan comúnmente en el Continente de Europa. Protegen al consumidor contra productos deficientes o poco seguros y aseguran que las mercancías ofrecidas alcanzan un nivel reconocido.

Hace tiempo que tales pruebas se llevan a cabo voluntariamente en el Reino Unido y se usan actualmente varias marcas de aprobación. En febrero de este año, sin embargo, el Consejo de la CEE publicó una importante guía, usualmente conocida como la Guía sobre Bajo Voltaje, con la que se propone armonizar las normas de seguridad de ciertos países miembros y facilitar así el comercio entre ellos. La Guía consiste en un preámbulo y catorce artículos; de los cuales el décimo tercero exige que todos los estados miembros empiecen a cumplir con sus normas dentro del plazo de dieciocho meses a partir de su publicación.

Se ha publicado hace poco un nuevo Standard Británico para Aparatos de Alumbrado, el BS4533, y al mismo tiempo la Lighting Industry Federation y la British Standards Institution han producido un sistema de "Kite Marks". Este sistema garantiza la aprobación no sólo por medio de pruebas llevadas a cabo con aparatos individuales, sino también exigiendo que las instalaciones para pruebas de los fabricantes alcancen el nivel estipulado por la British Standards Institution y mediante la inspección periódica de sus instalaciones. Se está estudiando la necesidad de clasificar las superficies de montura y es posible que se dé carácter internacional a la clasificación. Posiblemente se las dividirá en tres grupos: incombustibles, normalmente inflamables y fácilmente inflamables. Los aparatos de alumbrado no deberán montarse en estas últimas.

Una medida recién adoptada en Alemania se refiere al peligro de que un reactor de un aparato de alumbrado se aciente al final de su vida y pegue fuego a la superficie en que está montado el aparato. La solución alemana es dejar espacio entre el reactor y el aparato y dejar espacio entre éste y la superficie en que va montado. Las lámparas de este diseño tienen derecho a la "Marca F", una F mayúscula dentro de un triángulo invertido. Los técnicos americanos utilizan circuitos térmicos que se ponen en operación cuando la temperatura del reactor alcanza un nivel peligroso. La armonización de los estándares nacionales de seguridad con vistas a unos estándares europeos completamente unificados está bien encaminada, y es de esperar que conduzca al establecimiento de estándares mundiales. El Reino Unido abrió la marcha con la adopción de estándares voluntarios y tenemos mucho que ofrecer a nuestros nuevos asociados del Mercado Común.

32 LAMPARAS MERCURIO-HALOGENAS PARA LAS ARTES GRAFICAS. A. L. Selway, y E. J. G. Beeson

La fabricación de planchas para las artes gráficas es un gran negocio. Es un proceso fotográfico y depende del uso de una fuente de luz rica en la parte ultravioleta del espectro. Durante muchos años se han usado lámparas de arco de carbono, pero éstas han sido reemplazadas por otras fuentes, en particular por arcos pulsados a Xenón. Se han usado lámparas fluorescentes que emiten rayos ultravioletas, pero la necesidad de utilizar varios tubos para obtener la cantidad de luz deseada tiene por resultado la desventaja del "contraste", ausente cuando se usa una fuente concentrada en un punto.

A raíz de la introducción reciente de lámparas de descarga mercurio-halógenas se usan fuentes lineares de 1200w en algunas imprentas importantes. En particular se ha estandarizado esta lámpara para usarse en la Agfa Gavaert en su sistema "Gevaproof". Sin embargo, la lámpara MBIL de 1200w es demasiado grande para las imprentas pequeñas, y tenía algunas desventajas técnicas. Acaba de desarrollarse una lámpara MBIL de 400w sellada dentro de un envoltorio PAR 64 que ofrece varias ventajas. El haz enfocado de antemano con exactitud permite una radiación bastante uniforme sobre una superficie rectangular del tamaño corriente de un pequeño chasis y la lámpara puede sustituirse fácilmente por un arco de carbono si se monta en un aparato especialmente diseñado que incorpore un obturador operado magnéticamente y tenga un reactancia y encendedor. Esta aplicación de los ultravioleta a procesos de imprenta indica el interés creciente en las fuentes ultravioleta para usos más amplios, que los Laboratorios de Investigación y Desarrollo de la Thorn están estudiando.

36 AVONBANK — UN AÑO DE EXPERIENCIA (Lighting Design and Technology Vol. 5 No. 2 1973).

La ambientación controlada en Avonbank, las oficinas de la South Western Electricity Board en Bristol, apareció descrita en *Lighting Journal* No. 7. Desde entonces se ha tenido de su uso más de un año de experiencia y en una reunión combinada de la IES y la Building Services Engineering Society se leyó un análisis describiendo el resultado.

Uno de los puntos más interesantes que resultó de este estudio es la reacción de la gente que trabaje en estas oficinas en estas nuevas condiciones. Se les pidió que llenaran un cuestionario antes de trasladarse de sus oficinas convencionales a Avonbank y pasado un intervalo de unos cuatro meses después de empezar a trabajar allí. Las respuestas a las preguntas están representadas en forma gráfica.

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nel questa edizio

6 HIPAK — UNA NUOVA PROGETTAZIONE. P. G. Harding.

Gli apparecchi per illuminazione di interni con altezze superiori alla media equipaggiati con lampade a scarica ad alta pressione sono noti da parecchi anni e, come molte delle attrezzature che sono state sviluppate e progettate tempo fa, essi tendono a risultare ingombranti, spesso pesanti e di difficile installazione. I progettisti della Thorn Lighting Development hanno deciso quindi di riesaminare questo argomento cercando di migliorare la linea e la struttura degli stessi. Una accurata indagine è stata quindi condotta, compresa la consultazione di un certo numero di utilizzatori in tutto il mondo; come risultato abbiamo avuto modo di rilevare cinque fattori basilari per quello che riguarda la progettazione degli apparecchi suddetti, vale a dire elevato rendimento ottico, semplicità di linea, manutenzione rapida e altrettanto celere installazione, funzionamento sicuro, struttura resistente ed osservanza delle norme nazionali ed internazionali.

Gli apparecchi realizzati come diretta conseguenza di questa accurata indagine hanno alcune caratteristiche insolite. La focalizzazione precisa di lampade da 250 o 400 watt in un riflettore in blocco unico è stata raggiunta per mezzo di un distanziatore. Si ha così una distribuzione migliore della luce e più alto rendimento. I sistemi di sospensione e di collegamento sono stati semplificati e il peso, a paragone con quello dei prototipi di un tempo, è risultato molto inferiore. I componenti sensibili al calore sono stati isolati dal reattore permettendo il funzionamento in temperatura ambiente fino a 40°C. L'apparecchio è del tipo anticorrosione ed è conforme ai requisiti di sperimentazione tecnica BS 4533. È stato sperimentato ed approvato sulla scorta del codice di protezione internazionale, standard IP22, e ha ottenuto il riconoscimento "guite Industrieform 73" alla fiera commerciale di Hannover.

10 NUOVA ILLUMINAZIONE DELLA 'VITTORIA' ANA' Colin Horsfield

La Whitworth Hall, uno dei più vecchi palazzi dell'Università di Manchester, è una struttura di tipo gotico vittoriano disegnata da Waterhouse il quale gode forse maggiore fama per il Municipio di Manchester. Come altri palazzi del periodo, la Whitworth Hall è un parecchio filo da torcere per quello che riguarda l'illuminazione, in parte a causa dei vincoli che lo stile architettonico impone ed in parte a causa della diversità di impieghi a cui è adibita la Whitworth Hall.

Un tempo, illuminata a gas, fu dotata, nella fine degli anni '30, di 10 grandi pendenti ottagonali ciascuno dei quali conteneva una lampada da 300 watt e tre da 100 watt dietro ad eleganti pannelli in vetro opalino; questi erano sospesi in coppia alle travi del tetto. L'illuminazione derivante era inadeguata per la maggior parte degli scopi e quando la Hall veniva utilizzata per esami era necessario aumentare l'illuminazione per mezzo di tubi fluorescenti sospesi a catene.

Quando venne deciso di fare un "repulisti" della Hall e migliorare l'illuminazione, un team dell'Università con a capo il Dottor James Bell, lavorò con la stretta collaborazione degli esperti della Thorn Lighting escogitando una soluzione in base alla quale l'illuminazione principale proveniva da vari tipi di spotlight piazzati tra le travi del complicato tetto in legno. Furono sospesi dalle travi al fine di produrre un luccichio ed una certa "atmosfera". 10 complessi illuminanti a gas di stile antico in ferro battuto.

La luce principale, utilizzata durante gli esami e funzioni simili, proviene da un complesso di sei lampade da 1000W al tungsteno-iodio installate in proiettori tipo OHD direttamente al di sotto del bordo del tetto mentre la luce generale, per lo più indiretta, proviene da lampade da 300 watt tipo PAR 38 installate in coppia poco al di sopra delle travi a da Sunflood da 500 W orientati verso le pareti e il soffitto dal basso: grazie all'installazione in questa posizione si ottiene una riduzione della parte in penombra del soffitto e si migliora l'illuminazione a luce modellante delle travi stesse.

Le svassature delle finestre contengono ritratti appesi su pannelli di quercia con illuminazione speciale da tubi fluorescenti da 50W a luce bianca calda in apparecchi Arowslim con schermi in metallo dipinti dello stesso colore dei pannelli. Ciascuna delle 10 unità in ferro battuto che hanno sostituito i pendenti ottagonali è dotata di 18 lampade da 24 volt — 12 watt installate dove una volta vi erano gli ugelli del gas. L'alimentazione di dette lampade è a tensione inferiore alla nominale onde assicurare una durata superiore. Sulla base di ciascun pendente è installata una lampada tipo floodlight 150 watt — PAR 38 con lo scopo preciso di gettare luce verso l'alto mettendo in rilievo la doratura della volta.

Non vi è dubbio: le fotografie illustrano chiaramente il successo di questa soluzione. Si tratta di un esempio classico di quanto si può raggiungere quando un architetto e un tecnico dell'illuminazione collaborano fin dall'inizio.

14 SISTEMI ELETTRONICI DI CONTROLLO DELLA LUCE. B. Massey & I. J. Bramson.

I circuiti di controllo della luce vennero impiegati originariamente nei primi ed antichi sistemi di illuminazione elettrica nei teatri, luoghi nei quali era necessario per l'appunto escogitare un metodo che equivalesse all'abbassare le luci a gas. Per i sistemi a corrente continua allora disponibili vennero impiegati grossolani reostati con avvolgimento a filo ed oscuratori idraulici. Nei primi anni del 1930 la introduzione di alimentazione a corrente alternata rese possibile un controllo assai migliore ma i trasformatori variabili ed i reattori saturabili impiegati erano pur sempre ingombranti e l'introduzione della valvola rettificatrice a griglia pilota poco prima della guerra fu la progenitrice dei sistemi elettronici di comando.

Da allora i congegni Solid State che impiegano Thyristors e Triacs hanno portato alla realizzazione di apparecchiature incredibilmente compatte con perdite di potenza irrilevanti.

Sebbene le applicazioni più importanti siano tuttora per uso teatrale o in studi televisivi, i metodi attuali di controllo della luce stanno trovando applicazione ovunque si impiega l'illuminazione artificiale: la applicazione è valida sia per lampade fluorescenti, sia per il tipo a filamento in tungsteno.

Piccole unità di controllo, con banchi di due o più regolatori, sono disponibili per rappresentazioni diacustiche ed è possibile sia il controllo automatico, sia quello manuale in un certo numero di casi. Le luci possono essere regolate in aumento o in diminuzione, possono essere variate in sintonia con il commento musicale, oppure possono cambiare colore automaticamente in seconda della programmazione; sono inoltre disponibili "sistemi a memoria" nei quali interi programmi di illuminazione possono venire immagazzinati in un "cervello elettronico" e immessi in circuito quando e come richiesti. I teatri più importanti e gli studi televisivi impiegano sistemi quali il Thorn Q-file e il Q-Master che immagazzinano fino a 200 "memorie" in un complesso di misure modeste. Il controllo elettronico della luce viene ora impiegato in una molteplicità di impianti di illuminazione; dalle gallerie d'arte agli ospedali, in negozi, trafori e sottopassaggi. La Thorn Theatre Lighting Division è a disposizione per qualsiasi assistenza in relazione all'impiego di questi sistemi.

23 ILLUMINAZIONE DEL SOTTOPASSAGGIO WICK ROAD ALONDRA.

Questo sottopassaggio, recentemente terminato, è costituito da una galleria curva a tre corsie lunga 152 metri; due cornici fluorescenti continue danno una illuminazione media di 250 lux durante il giorno e 56 lux di notte con metà delle lampade spente.

Lampade koloson (SON/T) in apparecchi di accurata progettazione portano l'illuminazione all'ingresso ad un livello pari a 3000 lux nei giorni di sole, riducendo la stessa in due fasi di 2000 e 1100 lux al livello di base. Nei giorni in cui l'illuminazione esterna è inferiore a 2000 lux, metà delle lampade nel tratto iniziale vengono spente per mezzo di fotocellule.

Nel primo tratto di 50 metri della galleria sono state realizzate scanalature trasversali ciascuna comprendente due lampade SON/T da 400 watt in proiettori parabolici installati con interesse da 1,5 metri.

Questi sono inclinati verso l'entrata producendo così una illuminazione totale di 3000 lux al livello della strada; nella seconda sezione di 50 metri la distanza è aumentata a 3 metri riducendo l'illuminazione a 2000 lux e infine nella terza sezione sono impiegate lampade SON da 250 watt che portano l'illuminazione a 1100 lux. Gli apparecchi sono stati progettati da tecnici della Electrical Services Division del reparto di architettura e progettazione civica del Greater London Council, fabbricati dalla Thorn Lighting Ltd. e installati dalla Green and Silleywell Ltd.

25 PROGETTAZIONE DI LAMPADE QUALI ELEMENTI DECORATIVI. Dr. G. E. Coxon.

Le "lampade fantasia", progettate più per effetti decorativi che quali sorgenti di luce, comparvero pochi anni dopo la realizzazione delle lampade primitive a filamento di carbone di Swan ed Edison. Alcune avevano una forma insolita con bulbi colorati o variamente rifiniti, altri ricalcavano un po' i precedenti articoli d'illuminazione, come le comuni candele.

Non appena a inizio l'uso del filamento metallico, questi tipi speciali di lampade continuarono a sussistere, inoltre ad essi vennero ad aggiungersi le lampade ad incandescenza tubolari che furono introdotte nel periodo tra le due grandi guerre. Tali lampade sono tuttora impiegate per l'illuminazione delle vetrine per gioielleria.

Recentemente, l'interesse verso le lampade di tipo decorativo è rinato, portando con sé una nuova concezione nella progettazione, basata su tecniche di produzione di massa. Ciò ha imposto non poche variazioni nel settore della fabbricazione; infatti ha richiesto l'impiego di lacche colorate da applicarsi sulle superfici del vetro invece di provvedere alla soffiatura dei bulbi con pasta di vetro colorato.

L'argenteratura all'interno, sia nella lampada tipo Reflector in vetro soffiato, sia nel tipo con cupola argentata, è ora sempre più popolare e la smerigliatura interna in sicilite è parimenti comune. Le lacche colorate vanno essiccate sul vetro ed è pertanto fondamentale il controllo accurato della temperatura in sede di fabbricazione. Questi rivestimenti possono anche influire sulla temperatura di esercizio della lampada.

Uno sviluppo recente consiste nell'impiego di filtri dielettrici per ottenere sorgenti colorate e sorgenti "a luce fredda".

La tendenza verso nuove forme e colori di lampade con caratteristiche decorative ricalca molto le idee del passato, ma l'impiego di nuovi materiali e di tecniche più avanzate dimostra chiaramente che queste idee sono pur sempre con noi dopo 100 e più anni progressi nella scienza dell'illuminazione.

29 KITE MARKS E/F MARKS. R. C. Kember, J. E. Greenhill, L.H. Da Volla.

I "marchi di qualità", di approvazione governativa, sono largamente diffusi nell'Europa Continentale. Essi proteggono il cliente da quei prodotti poco sicuri e danno la garanzia che le merci in vendita sono di una certa qualità.

Tale consuetudine è molto diffusa nel Regno Unito su iniziativa volontaria e vi sono numerosi "marchi di qualità". Nel febbraio di quest'anno il Comitato della Comunità Economica Europea ha emanato una importante direttiva volta a standardizzare le norme di sicurezza nei paesi membri della comunità, facilitando così lo scambio commerciale. La direttiva comprende una introduzione e 14 articoli, il tredicesimo dice per l'appunto che i membri si interessino ad ottemperare quanto in essa contenuto entro 18 mesi dalla data di emissione.

È stato recentemente emesso un nuovo British Standard per gli apparecchi d'illuminazione BS 4533. Allo stesso tempo la Lighting Industry Federation e la British Standards Institution hanno introdotto un sistema "kite-mark". Questo garantisce la qualità non solo con la sperimentazione individuale degli apparecchi d'illuminazione, ma altresì richiedendo che le attrezzature di sperimentazione dei fabbricanti siano in linea con le norme del BSI: il tutto corredato di un'ispezione periodica degli stabilimenti.

La necessità di classificare le superfici di supporto degli apparecchi d'illuminazione sta ricevendo l'attenzione di tutti e molto probabilmente si rifletterà su scale internazionali. Le superfici probabilmente saranno suddivise in tre gruppi: incombustibile, facilmente infiammabile e altamente infiammabile. Gli apparecchi d'illuminazione non vanno montati su quest'ultimo tipo.

Una recente disposizione in Germania riguarda il pericolo che un alimentatore da una apparecchiatura d'illuminazione si surriscaldi al termine della vita utile, il che potrebbe dar fuoco alla superficie sulla quale l'attrezzatura è appoggiata. La soluzione dei tedeschi è di collocare l'alimentatore lontano dall'apparecchio e tenerlo quasi ultimo distanziato dalla superficie di supporto. Gli apparecchi così realizzati probabilmente riceveranno il contrassegno "F mark": si tratta di una lettera F maiuscola racchiusa in un triangolo con il vertice verso il basso. I tecnici americani usano tali termini che entrano in funzione quando la temperatura dell'alimentatore raggiunge un livello pericoloso.

Un accordo tra le norme nazionali di sicurezza che porterà a una legislazione unificata europea, nonché ad un unico marchio europeo di qualità, è già a buon passo: si augura che ben presto da ciò nasca una serie di norme a carattere mondiale. Il Regno Unito è stato il primo ad adottare il marchio di qualità volontario; riteniamo di avere non poche cose da offrire ai nostri partner nel Mercato Comune.

32 LAMPADE A IODURI METALLICI PER LE ARTI GRAFICHE. A. L. Salway, E. J. G. Beeson.

La lavorazione delle lastre è di importanza primaria nel campo delle arti grafiche. Si tratta di un processo fotografico che richiede una fonte di luce ricca di raggi ultravioletti. Per molti anni sono state impiegate lampade ad arco fra elettrodi di carbone ma queste sono ora state sorpassate da altre fonti, in particolare archi allo xenon ad impulsi. Sono state impiegate lampade fluorescenti con emissione di ultravioletto ma la necessità di usare vari tubi per conseguire l'illuminazione richiesta ha portato con sé il grave svantaggio del "undercutting" che non si nota impiegando una sorgente unica.

La recente introduzione di lampade a scarica a ioduri metallici ha permesso l'impiego di sorgenti lineari da 1200 watt in importanti lavori di stampa. In particolare questa lampada è stata adottata dalla Agfa Gevaert per il sistema "Gevaproof". La lampada MBIL da 1200 watt è troppo grande per lo stampatore minore e in aggiunta presentava svantaggi tecnici.

È stata ora progettata una lampada MBIL da 400 watt sigillata in un bulbo PAR 64; l'insieme offre un certo numero di vantaggi: il fascio di luce accuratamente messo a fuoco dà una radiazione abbastanza uniforme su un'area rettangolare equivalente alla misura media di un telaio per stampa e la lampada può facilmente sostituire il tipo ad arco fra elettrodi di carbone se installata in un apparecchio appositamente progettato che comprende un ritrattore azionato magneticamente e il circuito di avviamento e di comando. Questa applicazione dell'ultravioletto per i processi di stampa indica appunto l'interesse verso le sorgenti ultraviolette per settori sempre più numerosi che sono appunto di primaria attenzione dei laboratori della Thorn Research and Development.

36 AVONBANK — L'ESPERIENZA DI UN ANNO.

(Lighting Design and Technology Vol. 1 5 N. 2 1973) La rivista Lighting Journal N 7 riporta interessanti dati in merito alle caratteristiche ambientali controllate ad Avonbank, gli uffici di Bristol della South Western Electricity Boards. A partire dalla pubblicazione in questione è passato un anno ricco di esperienze, in merito a quanto sopra che è stato debitamente relazione ad una riunione della IES e della Building Service Engineering Society.

Uno dei più interessanti punti venuto alla luce da questa ricerca è stata la reazione degli impiegati che svolgono le loro mansioni in questi uffici. È stato chiesto loro di riempire un questionario prima di trasferirsi ad Avonbank dagli uffici di carattere convenzionale e dopo un intervallo di 4 mesi è stato chiesto loro di riempire un altro questionario dopo che essi erano nelle nuove sedi di lavoro. Le risposte alle domande sono illustrate in forma grafica. Questi risultati sono pubblicati con il permesso degli autori della relazione, il Signor Wood-Robinson e Signor Ian Crichton, e con il permesso della IES che già li ha riportati nelle Transactions.

Hipak - a design exercise

by P G Harding

Like most things which have been developed piecemeal, the majority of high-bay fittings, although robust and giving excellent light control, are frequently heavy, difficult to install, costly and somewhat clumsy in appearance. Thorn Lighting engineers and designers decided to look at them afresh to see how their design could be improved.

Thorn Lighting is an international company and from the outset it was appreciated that the total market was the world, not the UK with Europe. Therefore to assist us in our research at the concept stage we approached interested parties, including practising engineers, throughout the world.

Four basic design requirements were eventually established :

- 1) High optical efficiency ;
- 2) Simple, quick installation and maintenance ;
- 3) Tough construction and reliable operation ;
- 4) Compliance with national specifications.

OPTICAL DESIGN

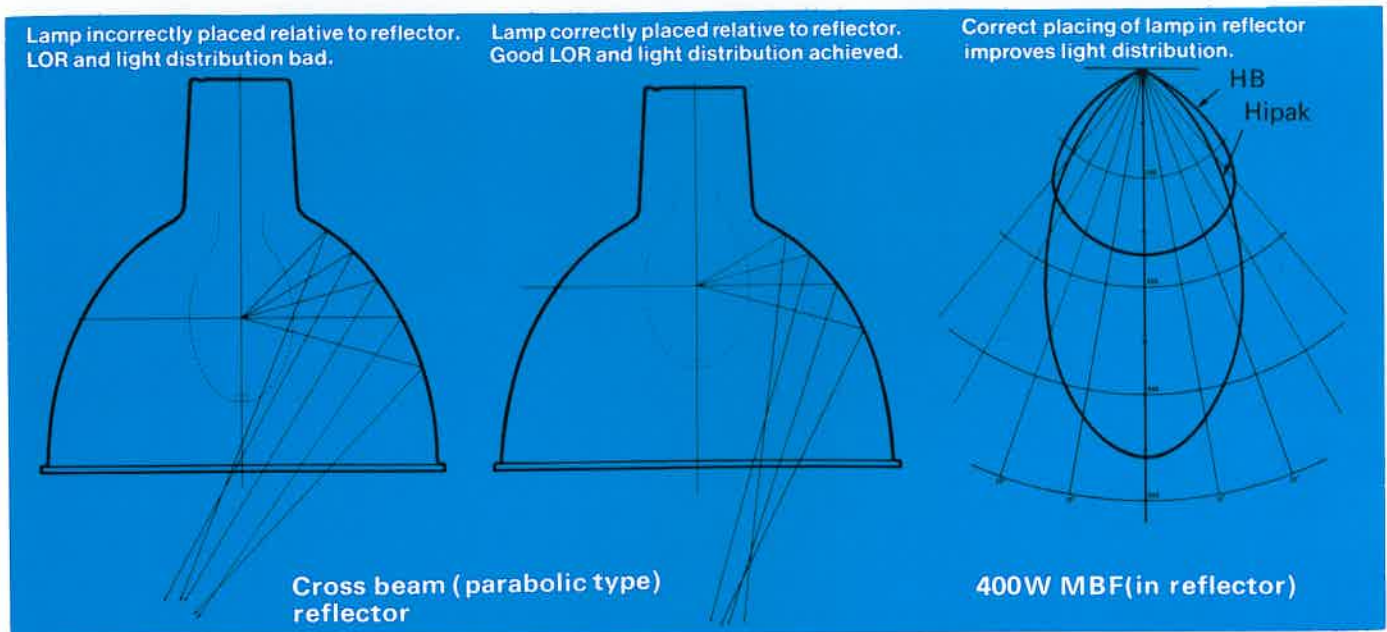
A luminaire is of little value if, due to poor optical design, it is unable to provide light of the desired intensity where it is required. If the maximum light output and control is to be achieved, the centre of the discharge column within the lamp must be at the focal point of a correctly designed reflector. Since the 250W and 400W elliptical lamps are of different sizes, to produce the maximum light output would require two reflectors, but from an economic point of view this is obviously not viable.

In the past a compromise was made, with the result that neither lamp was in the optimum position. Now the parabolic reflector for elliptical lamps has been redesigned and, by the introduction of a lamp-spacer fitted between the outer frame and lampholder, a significant improvement has been achieved. Two lamp-spacers, one for each type of lamp, position the light-centre of the lamp accurately relative to the reflector, for both lamp sizes. Accurate placing of the reflector improves the light output ratio and light distribution of the fitting (Table 1).

	LOR %		Lighting design Lumens
	Old fitting	Atlas Hipak	
250W MBFR	89	92	10 500
400W MBIF	76	87	27 000
400W SON	77	80	40 000

Table 1 LOR comparison

P G Harding is Product Executive for Industrial Luminaires, Thorn Lighting.





The reflector is made from spun aluminium. It is chemically brightened and anodised. To avoid fatigue problems around the reflector suspension points, a plated steel reinforcing plate is introduced at the neck of the reflector which has been enlarged in diameter to permit greater accessibility.

Where reflector lamps are used a spun aluminium skirt takes the place of the reflector. This, too, has been simplified in design and is easily positioned by means of keyhole slots.

INSTALLATION

A fitting which presents difficulties during installation – such as an inaccessible terminal block – will take much longer to install than one which is straightforward. The hidden cost this represents is sometimes not appreciated until the final bill is presented. The installing electrician should not be forgotten either. He may be 8m above the ground, perhaps in an inaccessible position, and his task becomes even harder if fittings are heavy and present wiring or suspension difficulties. Fittings designed with easy installation in mind bring benefits to the user in financial terms and in the standard of the final work.

In the Atlas Hipak fitting the wiring box is large and there are no parts to drop. A large terminal block, capable of taking 4mm² looped cable, is provided. A variety of cable types may be used, seals being effected by glands or conduit, and there are suspension points for flexible or tube drop methods. Weight reductions ranging from 10-53% have been achieved (Table 2) mainly by the sensible choice of materials and the use of ignitor circuitry for the high pressure sodium or metal halide lamps.

RELIABLE OPERATION

Prolonged, reliable service is expected of these luminaires which are often infrequently maintained even where environmental conditions are severe. Warm humid atmospheres, perhaps carrying airborne dusts or corrosive agents, are not unrepresentative of the more extreme conditions encountered. Mechanical stress is also often present; a typical source of such stress, found in many industrial premises, is a travelling gantry crane. Unless the luminaires are designed to resist the vibrations of the structure produced by the motion of the gantry, premature component failure could result.

If the fitting has not been designed for prolonged operation in the areas where it will find most use, it will fail. The two major problem areas for the designer to tackle are thermal and mechanical.

Old and new types compared. The Hipak fittings are on the right of each pair.

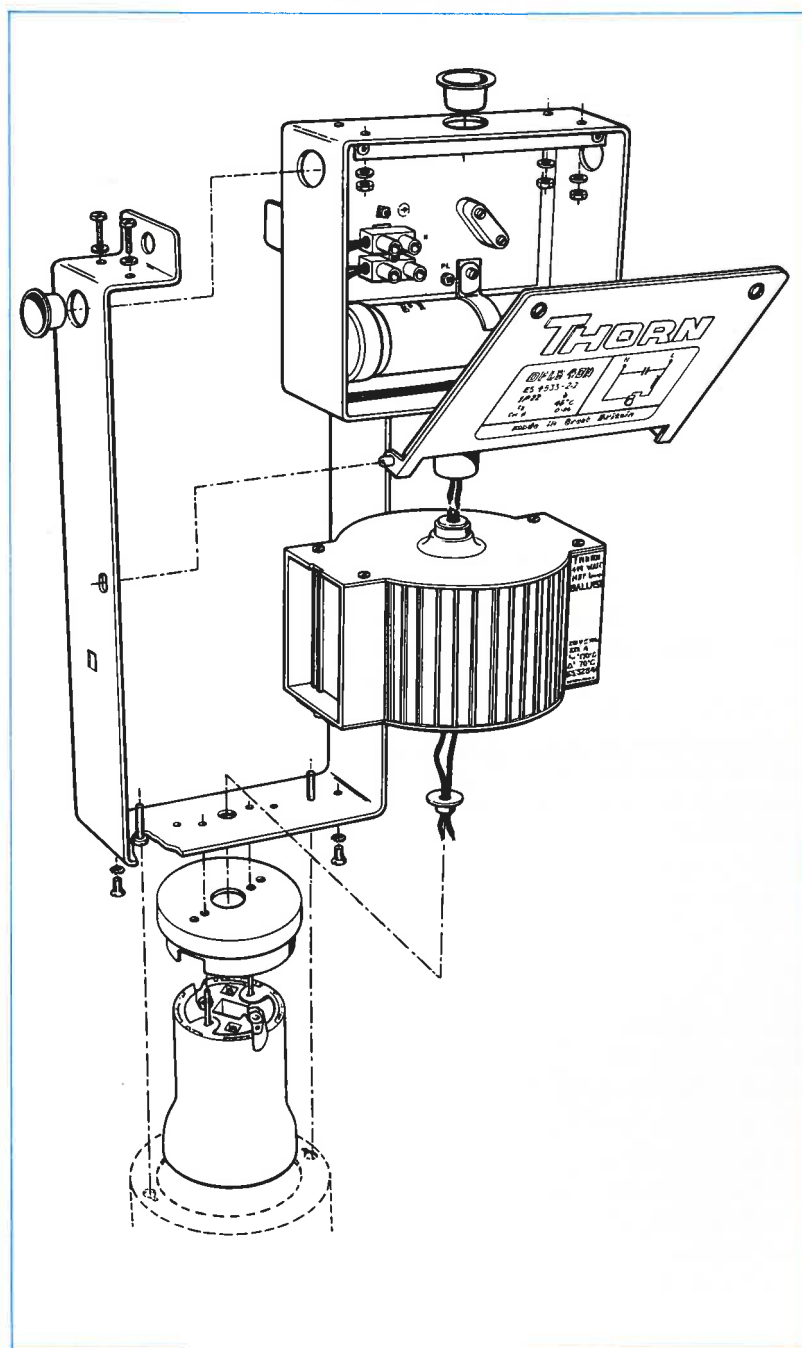
Fitting	Approximate weight (kg)		Approximate decrease
	HB range	Hipak	
250W MBFR	7.00	6.30	10%
400W MBFR	9.20	7.20	21.5%
250W MBF	8.60	7.25	15.5%
400W MBF	10.50	8.15	24%
250W SON	13.60	9.15	32%
400W SON	15.40	10.25	33.5%
400W MBI	18.40	8.55	53%

Table 2

Heat considerations

Next to the lamp itself, the hottest component in a discharge circuit is the ballast. The heat generated in operation could adversely affect the performance and ultimate life of other components such as capacitors. From market research it was established that many areas where high-bay fittings were used could reach ambient temperatures in excess of 40°C. To achieve satisfactory operation in these very warm conditions prototypes were built and tests were run on a number of designs. Finally, it was decided to encapsulate a precision wound ballast into an aluminium extrusion. The extrusion was designed to accommodate ballasts for both high pressure sodium and mercury as well as metal halide lamps within its section.

Vertically finned and finished matt black, the ballast unit has proved most efficient at dispersing internally generated heat, while, since the same extrusion is used to house different types of gear, only one production tool is required. Because the ballast was a self-contained unit it was possible to place the other temperature-sensitive components away from its immediate vicinity, so allowing them to run within their thermal limits. The terminal block and capacitor – and



Exploded view of Hipak components. The capacitor and connecting box are separated from the ballast in its finned aluminium housing. The thickness of the spacers between frame and lampholder is varied to suit the size of lamp.

ignitor when required – were housed together in one box, fitting neatly into the outer frame and separated from the ballast by an air gap ; heat-transfer from this component was thus minimised.

Strength and resistance to corrosion

Careful consideration was given to the constructional materials. As previously described, the ballast is encapsulated in an aluminium extrusion. Aluminium has satisfactory corrosion-resistant properties in most atmospheres but, as a further precaution, the extrusion has been painted with a black matt-finish paint. For fittings using mercury vapour circuitry the wiring box is made of injection moulded polycarbonate which has excellent corrosion-resistant properties, is very tough, and is the material from which vandal-proof bowls for street lighting lanterns are manufactured. Fittings with circuitry for metal halide and high-pressure sodium sources use a stove enamel steel wiring box, the lids being common with the mercury fluorescent type, gasketed with close-cell neoprene and made from polycarbonate. The outer frame is fabricated from steel, galvanised and painted with a grey stove-enamelled paint. The components are held together by stainless steel screws. These measures ensure that the fittings can withstand most environmental conditions, even those as formidable as are found in steel mills where not only are all the 'corrosion evils' present but, because the fittings are often mounted in inaccessible positions, maintenance can be difficult.

COMPLIANCE WITH SPECIFICATIONS

Many countries, including Germany and Sweden, discourage the internal sale of fittings unless tests are conducted by and approval gained from their own national test houses. The differing requirements of these countries were taken into account at the design stage and Hipak has therefore not only been designed, manufactured and tested to BS 4533 – the new British Standard for lighting fittings – but to meet international market conditions.

Thermal testing to BS 4533 is particularly onerous. Components must all operate within their thermal limitations at a voltage rated 10% above normal and for the UK this means running them at 264V compared with 240V. Under these conditions components become unusually warm and against this background it is even more remarkable that Hipak has been rated as suitable for operation in ambient temperatures of 45°C.

Because they are likely to be used in semi-sheltered outdoor locations, the fittings have also been tested and approved to IP22, that is, they are rated as drip-proof. The IP code is the International Protection Code and is widely used and understood as signifying an agreed standard of protection.

Conclusion

Industrial design is a process from which frustration, repeated revision and compromise is seldom absent. The designer must satisfy the design parameters in full while maintaining an awareness and an appreciation of both the cost targets and the production methods at his disposal. He must not isolate himself from the opinions of his colleagues, the development and production engineers. Yet from him we demand originality and flair. It is a challenge indeed, and the illustrations clearly show how well the designer, Colin Dipper, Dip.A.D., L.S.I.A., succeeded in meeting it.

Hipak has a strong visual identity, the emphasis being placed on function. By a bold design approach many of the problems inherent with this type of fitting – such as heat, installation difficulties and corrosion – have been successfully overcome. All the requirements needed to satisfy the demands of an international market have been met – as the presentation of a design award (Die Gute Industrieform 1973) at the Hanover Trade Fair this year demonstrates.

Victoriana relighted

by Colin Horsfield B Tech

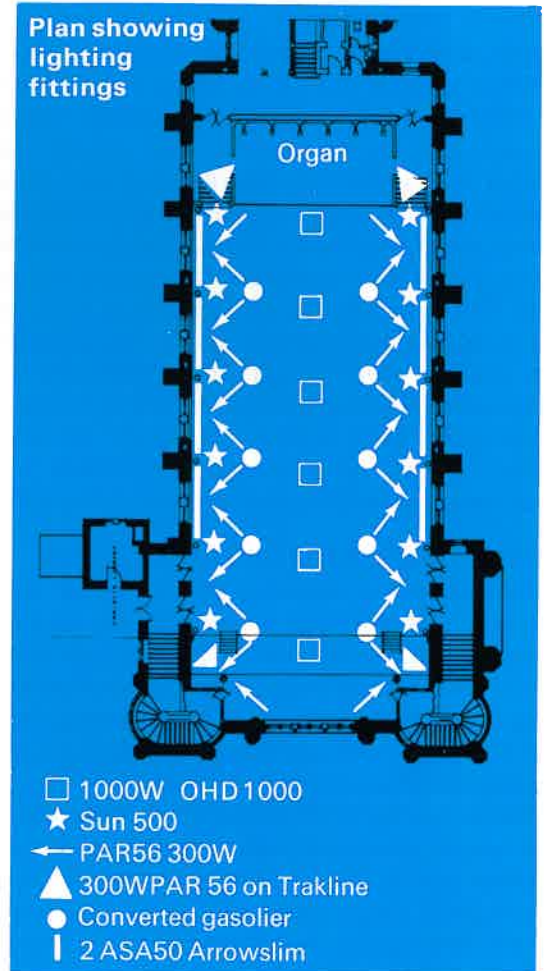
The Whitworth Hall, one of the oldest buildings of Manchester University, is a distinguished Victorian high gothic structure designed by Waterhouse, the architect of Manchester Town Hall. Built of white stone, with an elaborate hammer-beam roof, it is panelled in oak to the level of the window-sills, and portraits of chancellors and benefactors of the university are hung around the walls. The platform end is completely filled by an enormous pipe organ and the general effect is something between Middle Temple Hall and a large methodist church.

Such buildings are to be found all over the country and they present a difficult lighting problem. They are of sufficiently strong architectural character to merit careful treatment but they are used for such a variety of purposes that their lighting must often be functional as well as decorative. Unlike the halls of medieval colleges, which it so closely resembles, the one thing the Whitworth Hall is not used for is eating. It is the scene of numerous activities ranging from orchestral or choral concerts to school prize-givings; it is used for lectures, dances and social functions and as well as being the scene of the bestowal of degrees it is one of the chief examination rooms of the University. Nearly all these functions take place in the afternoon or evening so that the great majority of them are held under artificial light. Consequently, the lighting scheme provided must not only be keyed in to a very distinctive architectural setting but also be extremely versatile in use: able to provide a high level of general illumination in some circumstances, in others to produce a restful atmosphere and in yet others a dramatic one.

The oak ceiling and panelling were originally stained dark brown and the hall, which must have been lit by gas when it was first built, was relighted in the 1930s by a system of large hexagonal pendants, vaguely gothic in shape, housing filament lamps behind white opal glass panels. These were hung from the ends of the hammer beams; each housed one 750W and three 200W lamps and the maximum illumination achieved was in the order of 100 lux. Walls and ceiling and most of the vast organ case were lost in gloom and the general effect was heavy and depressing. When the room was used for examinations the inadequate illumination was augmented by the light from fluorescent batten fittings hung from the tie bars.

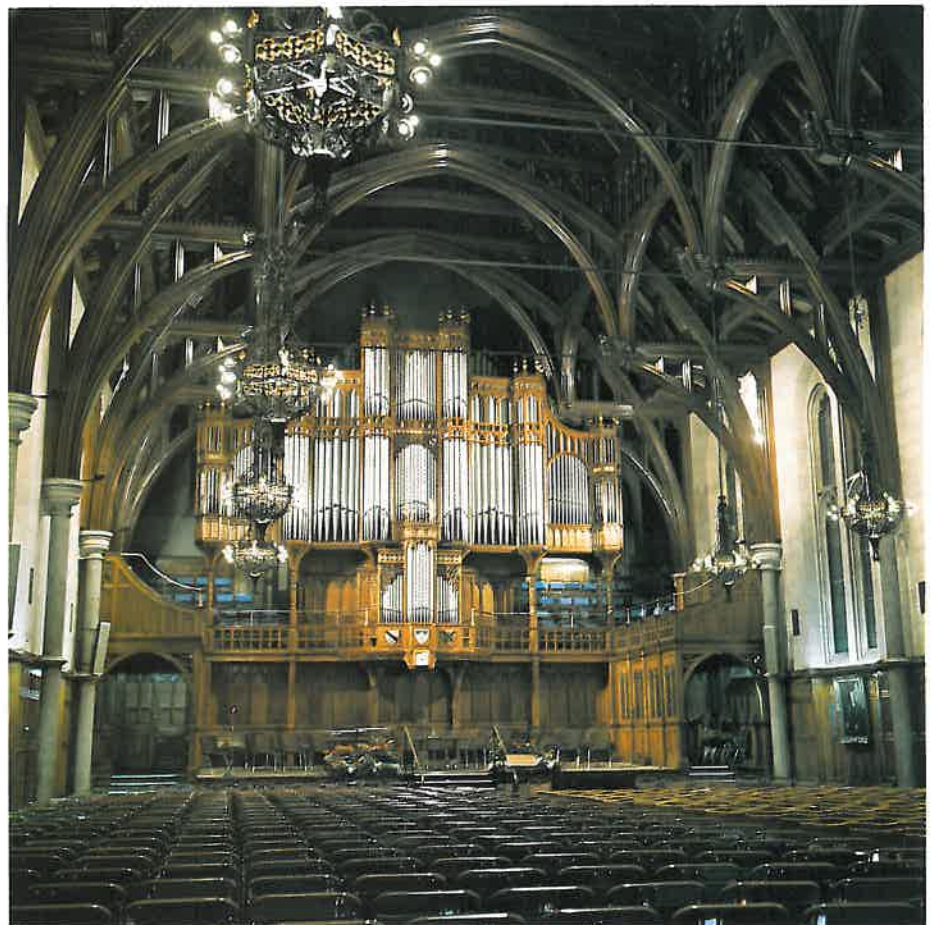
When it was decided to clean and restore the hall, it was seen that the lighting system must be improved as well. The University Building Team decided that the visual effect of the original gas pendants ought to be reproduced, but that the working light must come from modern equipment, concealed as far as possible in the elaborate roof. They found the perfect answer to the initial problem in a set of wrought-iron gasoliers of almost exactly the same date as the building—they came from a redundant local church—and these, suitably converted, were hung from the hammer beams in the original positions. They contribute little or nothing to the general illumination level and are regarded purely as decorative and atmospheric.

The basic lighting systems were worked out by Thorn Lighting engineers in close collaboration with the University Team. An experimental installation was set up in the front two bays to determine mounting positions and beam patterns and it was decided at this stage that all general light sources should be incandescent lamps as none of the discharge lamps tried provided the correct colour rendition of the cleaned stone and woodwork. This decision proved





The Whitworth Hall seen (above) from the platform and (right) as the audience sees it. Lamps on the hammerbeams are shielded from view.



fortunate, when, at a later stage, it was decided to put the powerful overhead lights employed when the room was used for examinations on dimmer control.

The final scheme resolved itself into three main sections, each providing light of a different character to suit different uses of the hall. For its use as an examination room functional lighting had to be provided; for general purposes a system of floodlighting the walls and ceiling was evolved; and for the more dramatic effects required at social functions and dances a system of picture lighting combined with the decorative pendants is installed. Each section can be used independently or in conjunction with the others.

The lighting of the central area presented few difficulties. For this purpose six 1 000W tungsten-halogen lamps were mounted in OHD reflectors in the apex of the roof; they give an illuminance of 300 lux at table level. Although these fittings tend to give strong modelling when operated alone, the effect is softened by other sources.

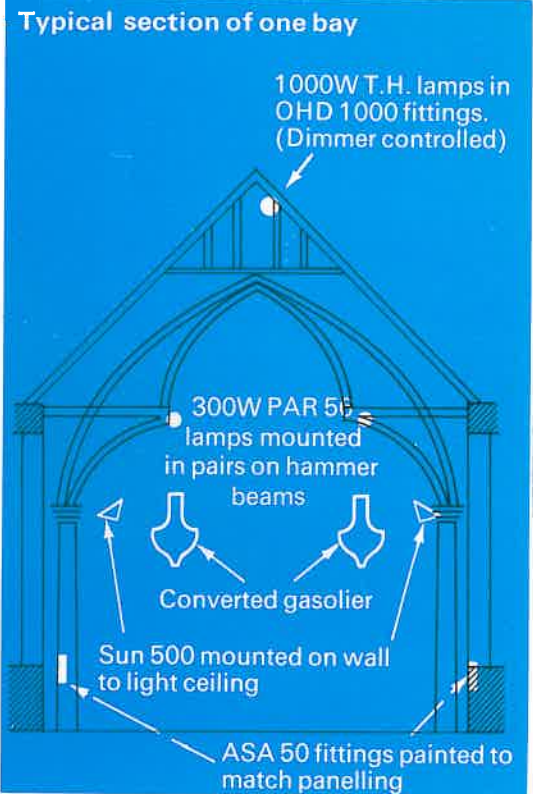
The general lighting is mainly indirect, that is to say the effect is achieved by directing the light on the walls and ceiling, although there is a certain amount of spill-light from the 300W PAR 56 lamps mounted on the hammer beams, which is valuable in providing some directional modelling.

The roof was lighted by 500W tungsten-halogen Sunfloods mounted on the capitals of the free-standing shafts between the windows; the fittings were inverted and set to an angle so that there is minimum reflector shine to a person standing on the far side of the hall. These fittings floodlight the roof and upper areas of the walls on both sides of the hall. By mounting the Sunfloods under the beams, minimum shadowing of the ceiling and improved modelling of the beams themselves were achieved.

The middle parts of the walls were floodlit by PAR 56 fittings mounted towards the end of the hammer beams; 300 watt wide-beam PAR 56 lamps were cross-projected in each bay, the major axis of the beam being orientated vertically and the spotlights aimed towards the mullions of the windows. Care was taken that bright images of the apertures in the beams were not projected on to the adjacent bay, and to eliminate dark patches in the central parts of the wall in the bays where there are no windows. This was achieved on completion of the installation by accurate alignment of each fitting. It was then found necessary to incorporate spill rings on to those fittings shining rearwards since, although they are mounted at a height of considerably over 30ft, there was some discomfort from the bright image of the edge of the lamps.

The lower area behind the stage is wood-panelled while the part above is covered by an array of organ pipes. PAR 56 lamps with medium beam patterns were employed. They are carried on an 8ft length of Atlas Trakline mounted vertically at the edge of the first hammer beam, and the beam patterns of the lamps are orientated horizontally working down the wall to the stage below. The light is cross-projected from either side and the modelling of the features is good, with strong high-light and shine from the organ pipes. The faces of people standing at the front edge of the stage are, perhaps, too strongly modelled when only the stage lights are in operation, but this is softened when the general hall lights are in use. If the floodlights had been taken back to the next beam, the modelling would have been softened, but the glare at the speaker's position would have been increased, and the problem of shadows cast by the first hammer beam on to the front wall would have become significant.

The rear wall is treated in a similar manner but with only three floodlights on each side. These are directed towards the mullions of the large rear window; two wide beams are orientated vertically and one medium beam is directed horizontally on to the lower sill. The flood-



Converted gasolier



lights are cross-projected and give good modelling of the stonework. The first four bays of the hall have windows and window seats. The existing lighting consisted of strip lights above the pictures, but it was felt that an increased luminance on the inside of this area, especially on the inside edges of the window mullions to complement the highlighted areas above, would be worth while. The effect is achieved by mounting two ASA 50 Arrowslim fittings butted end-to-end in each window embrasure, the front baffles being painted to match the panelling. The upward light from these illuminates the lower areas of the window and the downward light illuminates the pictures and the upper area of the panelling. The colour and brightness of the fluorescent tubes was carefully selected, and in the end 5ft 50W warm whites were determined to be most appropriate but with eight inches of the outer ends of the tubes blacked off. To reduce the specular reflections on the oak panelling the lower half of the front baffle was painted black.

Each of the antique wrought iron gasoliers which replaced the original hexagonal pendants was equipped with eighteen 24V 12W clear bus lamps mounted in the positions of the original gas jets and slightly under-run to assume a reasonable life. A 150W PAR 38 floodlamp was mounted in the base of each pendant so that its light shone upwards and highlighted the gilded parts of the wrought iron. These lamps can be switched separately if required.

As can be seen from the photographs, the final effect is extremely satisfactory. A very important aspect of the design is the almost complete absence of specials. With the exception of the wrought-iron gasoliers, standard equipment has been used throughout—a classic example of what can be done when architect and lighting engineer collaborate from the very beginning of a scheme.

The University Team consisted of Dr James Bell and Mr Donald Buttress, who gave architectural and lighting advice; the Buildings Officer, Mr Jack Butterworth; Mr Fred Garside, the Assistant Buildings Officer; and the Electrical Engineer, Mr Norman Wilkins, to all of whom we are grateful for help in writing and illustrating this article.



electronic dimming systems

by B Massey and I J Bramson MISTC

With the general introduction of electric lighting at the end of the nineteenth century, many minds applied themselves to the problem of finding an electrical equivalent to the one advantage which gas lighting had to offer, namely, continuously variable control of brightness. The advantage was particularly evident in the theatre where the use of gas lighting, although presenting something of a fire hazard, had permitted considerable flexibility. To be acceptable to the lighting men of those days, electricity needed to offer a comparable facility.

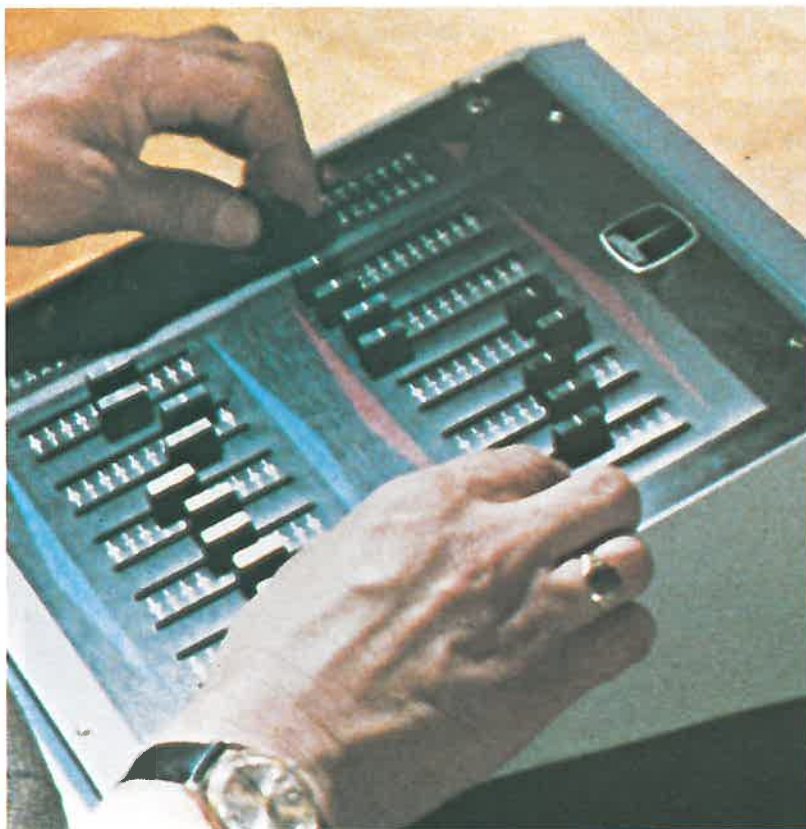
Early attempts to control the d.c. installations ranged from arrangements in which copper rods were immersed for a greater or lesser part of their length in conductive chemical solutions, to large wire-wound rheostats commonly controlled by means of hand wheels. In both cases much waste heat was generated and in the former arrangement the inconvenience was aggravated by corrosion and a tendency to generate noxious gases.

With the introduction of a.c. supplies in the early 1930s improved control became possible by two methods, the variable transformer and the saturable reactor. Both of these offered a reduction in wasted power, and saturable reactors were amenable to remote electrical control. However, both types were expensive and, because of their iron-cored inductors, were heavy and bulky.

It was not until the late 1930s that the advent of the gas-filled thermionic triode known as the 'thyatron', introduced an era in which electronic control techniques have resulted in dimmers which are now compact, efficient, inexpensive and controllable by means of a convenient low power d.c. signal.

The thyatron was the forerunner of the solid state device, now known as the thyristor, itself a precursor of the triac. Both devices are in current use as very high speed electronic switches controlling the energy

B Massey and I J Bramson are members of the Theatre Lighting Division of Thorn Lighting.



Constantly changing lights make a swinging scene. The Club 10 control unit can be seen in the background.

Control panel for Thorn Club 10.

supplied to the lamps but without themselves dissipating any appreciable amount of power. Dimmers employing this device are controlled by a low voltage d.c. signal—typically 10V at 1–2mA. This approach has resulted in dimmers which are very compact and have negligible power losses.

The theatre, then, was the first user of electronic dimming systems and, with television studios, remains the prime market for large installations. However, dimming methods are now finding application wherever artificial lighting is used and are equally applicable to both tungsten filament and fluorescent light sources.

Purpose-built equipment is now commercially available for installations ranging from a single lighting circuit to the most ambitious opera house application. The theatre-related establishments, discotheques, etc. are well catered for, as are bars, schools and restaurants. Economical, small and highly portable versions of the modern theatre lighting control system are currently available for any establishment making use of a small stage. In restaurants and pubs these systems may be employed to provide 'mood' lighting, using shape and colour to the maximum advantage. If a cabaret or other show is to be staged in the evening, a simple readjustment of the controls provides professional style stage lighting.

A good example of this type of control system is the Thorn Club 10 in which a lighting cue or state can be set up while the previous one is still in use. The equipment illustrated in Figure 1 employs a compact assembly of ten electronic dimmers and any combination of lanterns up to the maximum rating of the dimmer (2.5 kW) can be connected to each one of the ten circuit outlets. The control unit shown in the lower illustration is remote from the dimmers and is usually positioned at that point off stage which affords the best view for the operator. This unit operates at low voltage and is fitted with two rows of faders or control levers, each row being provided with a master fader. The latter allows control to be transferred at any chosen rate from one row or 'preset' of faders to the other, thus changing the lighting to the next required state.

The Club 10 is also the nucleus of a self-contained kit which includes all the lanterns, cables, filters, etc. required to build a basic stage-lighting installation. This package, called the Clubmaster, allows professionals or amateurs alike to achieve good results on a do-it-yourself basis. It can be expanded if necessary to suit a larger production.

Used with a similar dimmer pack, the Thorn Club Disco typifies a range of special purpose control units. These not only allow manual control of the light level of several different circuits from a single multi-control panel but can also allow some circuits automatically to pulse or fade from colour to colour according to the pitch, loudness and rhythm of a signal from a sound source. At the same time other circuits cross-fade continuously from one to another at predetermined speeds. This type of apparatus is useful in ballrooms and in restaurants with dance floors, since the same controls which provide these spectacular effects can, at the touch of a switch, give lighting conditions to produce a more restful atmosphere.

For more complex installations, sophisticated manual control systems are available. In the Thorn Series PM control board illustrated in Figure 2, the circuits, although individually controlled, can also be grouped to common master faders by the insertion of miniature contact-pins in a matrix of sockets. This renders the system more flexible and suitable for use with fast moving variety shows or complex dramas.

Larger theatres and TV studios use control systems with computer-type ferrite core stores which provide both circuit selection and circuit intensity memories. The Thorn Q-File and Q-Master equipments, typical of the ferrite memory systems, have been supplied to many theatres and TV studios throughout the world. These allow a



Figure 1

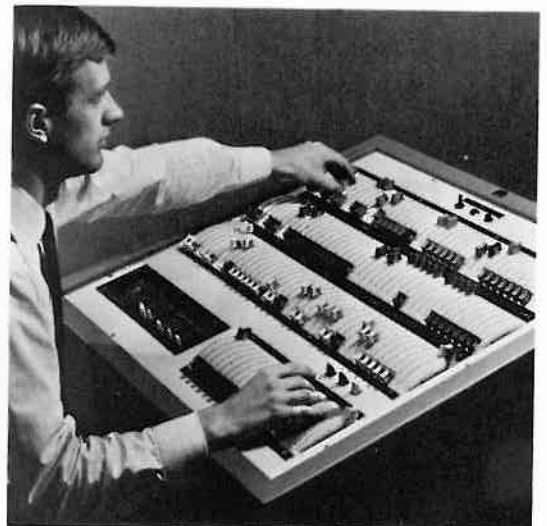


Figure 2

complete lighting state to be recorded at any time in one of up to 200 electronic memories. At the touch of a button any of these states can be recovered instantaneously or faded in to replace or supplement an existing lighting arrangement as quickly or slowly as required. Aurama, the Thorn control system for Son et Lumière, employs an electronic memory system and utilises a signal pulse from the unused track of the sound tape to change the floodlighting of buildings to synchronise with the narration and sound effects.

Lighting controlled by means of electronic dimming can be used on art displays, fountains, waxworks, etc, to produce a suitable atmosphere or to tell a story. Such systems are often controlled by a photo-electric cell arrangement which is activated when a visitor passes through the beam, or they may be mechanically or manually controlled.

Theatres, cinemas, lecture halls or conference suites using any form of slide or film projection require controllable auditorium lighting and dimmers having simple remote controls are available for this and similar applications. These remote controls take the form of a rotary knob or set of pushbuttons which respectively allow manual adjustment of brightness, or initiate automatic changes at a pre-determined rate between off and full light or some intermediate level. Units of this type are available to control either tungsten (including tungsten-halogen) or fluorescent lighting and the Thorn Series H range is a good example.

A combination of the last-described units and the photo-electric arrangements described earlier can be used in many interesting ways. For example, the lighting at the mouths of road tunnels can be automatically adjusted according to the daylight level and hence allow a less abrupt and safer transition between natural and artificial illumination. Shops, offices, factories and art galleries can have controls which maintain a set level as the daylight changes. Plants and animals can have their environments controlled in a manner which favours their optimum growth and development.

Other applications of controlled lighting are manifold. For example, hospital operating theatres can benefit by having the right amount of light of the right colour in the right place; and mental hospitals can use control of illumination level and colour to achieve a therapeutic effect.

Son et Lumière at Canterbury Cathedral



some recent installations



A Coffерlight ceiling provides glare-free illumination in an architect's office.

Right: Atlas Halide floodlights light a trotting track near Cannock, Staffs.





Above: Day and night views of outdoor lighting at Bass Charrington, Runcorn.

Right: The ceiling of the smaller concert hall at Stockholm lit by Atlas Sunfloods.



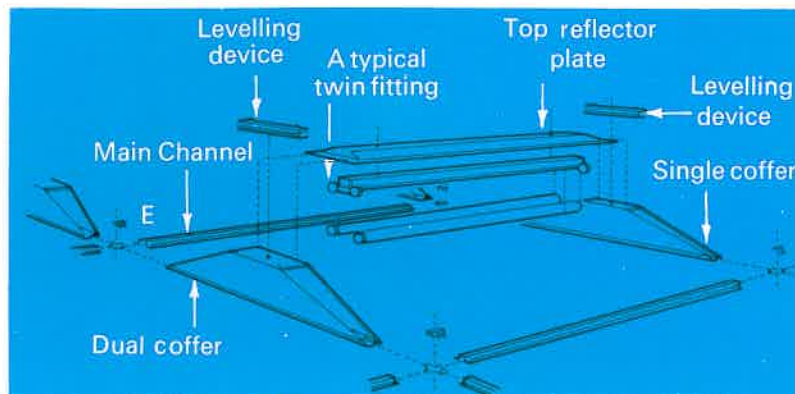
some recent installations

Technical notes

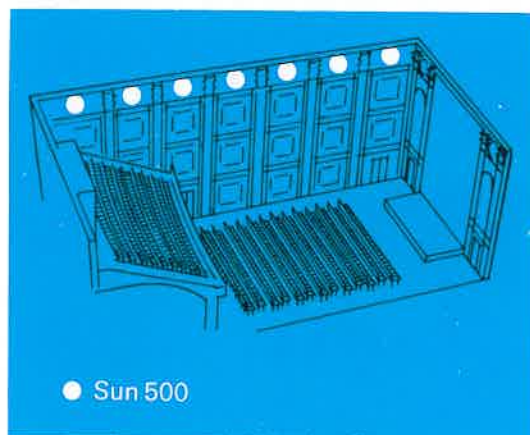
Cofferlight ceiling

The architectural firm of Peter M. Caller and Associates has chosen a Thorn Cofferlight ceiling for the new drawing office in Newcastle upon Tyne. The offices are housed in a Georgian building in which ceiling heights are limited and the elegant Cofferlight permits a high level of illumination without glare. A factor which influenced the choice of Cofferlight was that it is based on the 5ft 65W fluorescent lamp which has a higher lumen output than the 4ft 40W lamps around which similar systems are designed.

Twin Atlantic 4 fittings are used without diffusers in the 300mm deep, 600mm x 1800mm coffers which are supported by a single channel system. Designed illumination at the drawing board is 2000 lux.



Exploded view of Cofferlight

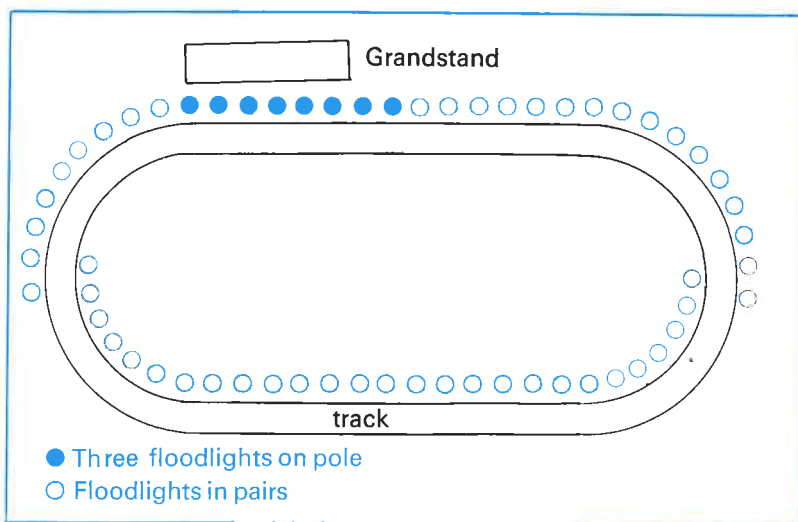


Stockholm concert hall

Stockholm's concert hall is one of the most elegant buildings in the city and is the scene of the annual distribution of Nobel prizes.

The smaller hall, used for chamber concerts, was originally lit by decorative pendants which, though elegant, failed to illuminate the painted ceiling adequately. To overcome this, extra lighting has now been provided from 14 500W tungsten-halogen lamps in Atlas Sunfloods mounted in the shallow cornices below the ceiling in each bay. The extra light cast on the paintings has brought out details hitherto unperceived, and the fittings are mounted far enough from the ceiling for there to be no heating problems.

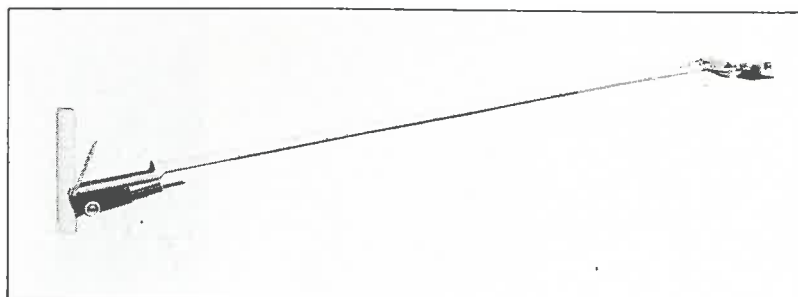
Sunfloods have also been used for emergency lighting and to supplement the lighting of foyers and cloakrooms.



Trotting track

The only purpose designed trotting track in England is at the Chasewater Raceway near Cannock in Staffordshire. To allow evening meetings throughout the year a permanent floodlighting installation consisting of 128 Atlas Halide HAS 1500 tungsten-halogen floodlights is installed. The floodlights are mounted on 8m Abacus tubular steel columns which can be hinged down at the base by means of a hydraulically operated counter-weight system for lamp maintenance. The floodlights are mounted in pairs except for the eight poles immediately in front of the grandstand where they are arranged in sets of three.

The designed horizontal and vertical illuminances on the main circuit are 150 lux and 200 lux respectively. In the grandstand area the values are 200 and 300 lux.



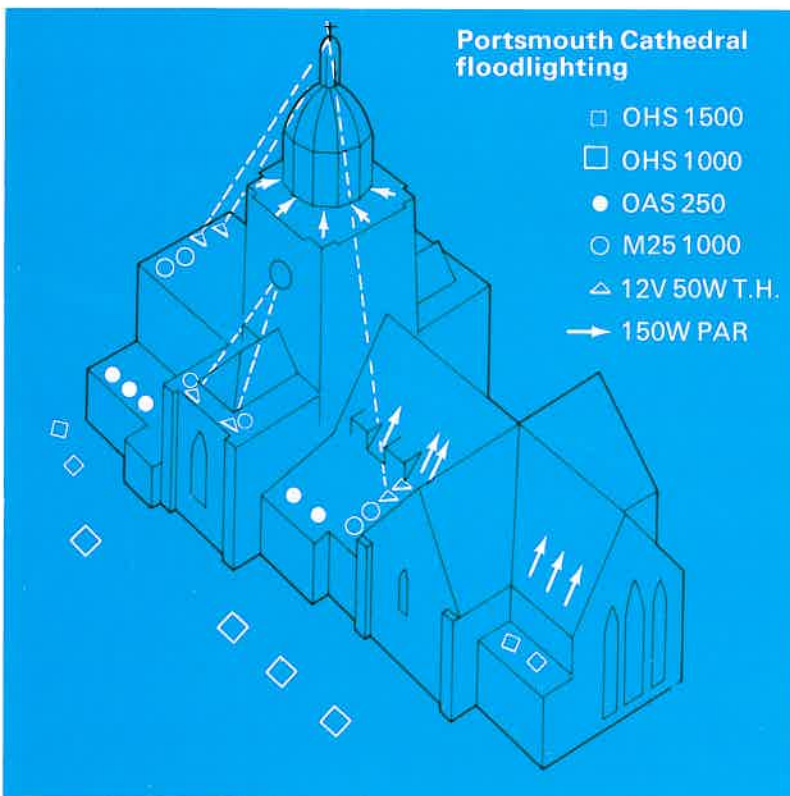
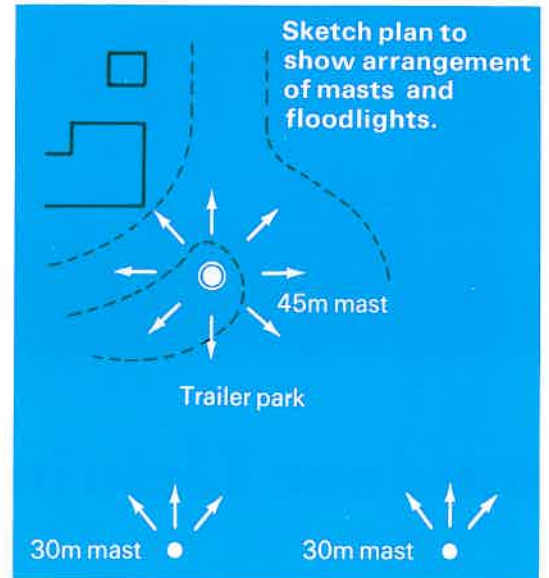
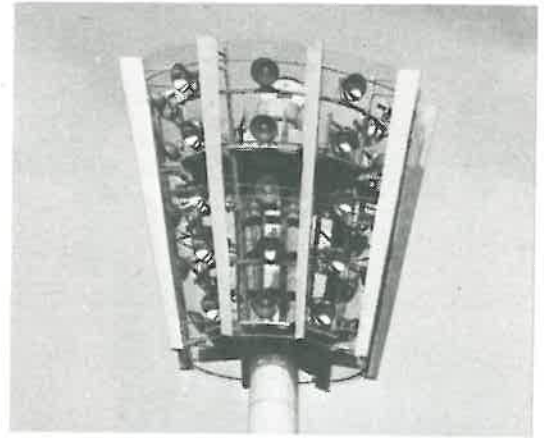
Bass Charrington

The floodlighting of a building site is by no means uncommon : what is less usual is an installation designed to be used both during construction and after the building is completed.

The system at Bass Charringtons' new bottling plant at Runcorn is based on three Petitjean masts, each carrying a 'corona' of floodlamps ; access is by a ladder within the hollow steel mast.

The 45m main mast, lighting the entrance area, supports 40 M25 floodlights each housing a 400W KolorSON lamp mounted at an angle in the crown-shaped frame to give an illumination of 20 lux at ground level. Control gear is housed within the mast.

Supplementary lighting for the trailer park is by two 30m high masts each carrying 24 floodlights ; these light areas which would otherwise be in shadow cast by the lighting equipment on the main tower. A general street lighting installation is provided in other parts of the site.



Portsmouth Cathedral (Page 22)

The central tower of Portsmouth Cathedral, completed in 1691, replaced the western tower of the original thirteenth-century cruciform parish church which now forms the choir of the cathedral. It has an octagonal bell-chamber supporting a lead cupola, terminating in a lantern and weathercock.

The flat roof of the modern nave and western transepts accommodate six M25 floodlights, each housing a 1000W lamp, to floodlight three walls of the tower ; with six specially designed low voltage spotlights, housing 12V 50W tungsten-halogen lamps, to pick out the clock on the south face of the tower and the weathercock.

The octagon and choir roofs are lit by 150W PAR lamps mounted on the flat roof of the tower and above the eaves of the pitched roof of the choir and the lower walls of nave and choir by tungsten-halogen lamps in OHS/500 reflectors mounted at ground level. The upper walls are picked out by 250W KolorSON lamps in area floods mounted on the flat aisle roofs.

The scheme was designed by Portsmouth City Architects' Department in close liaison with Thorn Lighting engineers and was installed by the Southern Electricity Board.



Outdoor Lighting Awards 1975

Although there are two years yet to go, considerable interest is already being shown in the Outdoor Lighting Awards timed to coincide with the London meeting of the CIE in the autumn of 1975. The sponsoring bodies are the Civic Trust, the Electricity Council (which will administer the scheme), the Lighting Industry Federation, the Local Authority Association of Great Britain and the Tourist Boards of England, Scotland, Wales and Northern Ireland (but *not*, as reported in the last issue of *Lighting Journal*, the IES). It is felt that the following details will prove useful to those contemplating entry.

Any body or corporation responsible for a suitable building or area is eligible to enter for the competition. Awards will be made for outstanding examples of the exterior lighting of buildings and open areas intended for the enjoyment of the public and the Sponsoring Committee offers to put would-be candidates in touch with lighting specialists where necessary.

Awards will be made in three classes :

- (a) Individual buildings, structures and their surroundings ;
- (b) Urban areas ;
- (c) Areas of natural landscape.

All installations must have been first switched on not earlier than 1 July 1972 or later than 31 December 1974, must be in use at all appropriate periods during 1975, be within the United Kingdom and be visible to the public without charge.

Entrants will be asked to submit photographs of their entries but the actual judging will be on site. There is no entrance fee.

Full details of the scheme may be obtained from the Secretary of the Sponsoring Committee, 1975 Outdoor Lighting Awards, Trafalgar Buildings, 1 Charing Cross, London SW1A 2DS.

Picture shows Portsmouth Cathedral floodlighting described on the previous page.

lighting a London underpass

London's newest underpass, recently completed by the Greater London Council, carries the south-bound carriageway of the A11 under Wick Road, Hackney. It consists of a 152m (500ft) long curved tunnel with three lanes of traffic.

The basic lighting is provided by two continuous cornices consisting of twin-lamp 5ft 65W fluorescent luminaires mounted end to end and producing an average illuminance of 250 lux by day and 80 lux at night when half of them are switched out. On a bright day the illumination at the entrance is raised to 3 000 lux and reduced by two stages of 2 000 lux and 1 100 lux to the basic level by means of Thorn KolorSON (SON/T) lamps in specially designed reflectors. On dull days, when the illumination outside falls to less than 20 000 lux, half the lamps in the initial stage are switched out by means of a photocell located near the entrance. This reduces the illuminance to the same level as that in the second stage.

By this means, drivers' eyes gradually become accustomed to the lower illumination in the tunnel and the effect of being suddenly plunged into darkness is avoided.

In the first 50m long section of the tunnel, transverse troughs about 600mm wide have been formed in the concrete on 1.5m centres. In each of them are two specular reflectors each housing a 400W clear-glass high-pressure sodium lamp (SON/T). These reflectors are tilted towards the entrance of the tunnel and, with the fluorescent cornices, produce an illuminance of 3 000 lux at road level. Tilting the

Vehicles enter a brightly lighted area. Further on the illumination is scaled down.





reflectors increases the apparent brightness of the walls and roof of the tunnel and also reduces the brightness of the unavoidable reflections of the lamps which appear to chase each other down the rear window and polished surfaces of the car in front.

On a dull day, when the external illuminance is less than 20 000 lux, alternate pairs of these fittings are switched out in the first section of the tunnel, thus increasing their effective spacing to 3m and reducing the illumination to 2 000 lux, the same as that of the second section, in which the spacing of the troughs has been increased to 3m.

In the third 50m section the troughs are still spaced at 3m, but the power of the SON/T lamps is reduced to 250W, bringing the total illuminance in that section down to 1 100 lux. The remaining part of the tunnel is lit to 250 lux by the fluorescent cornices only. Table A shows the relationship between external illuminances and the tunnel lighting.

The fittings housing the KolorSON lamps were made by Thorn Lighting to the design of engineers of the Electrical Services Division of the Department of Architecture and Civic Design of the GLC. They are totally enclosed, with a clear glass gasketed visor and polished anodised aluminium reflector of parabolic cross-section. The electrical and installation work was carried out by Green and Silleyweir, working under the main contractors.

The warm light of the KolorSON lamps contrasts with the cool colour of the fluorescents so that the impression given by the latter is that of a long line of clerestory windows admitting natural daylight. This very much lightens the appearance of the structure and eliminates the claustrophobic effect often felt in tunnels and underpasses.

Start of the second section showing how the spacing of the lamps is doubled.

External conditions in approach road	Zone I 50m	Zone II 50m	Zone III 50m	Basic 152m
Day (above 20 000 lux)	58 400W SON/T Soffit fittings 50 2 x 5ft 65W cornice fittings Average lux on road 3 000	32 400W SON/T Soffit fittings 56 2 x 5ft 65W cornice fittings Average lux on road 2 000	32 250W SON/T Soffit fittings 56 2 x 5ft 65W cornice fittings Average lux on road 1 100	148 2 x 5ft 65W cornice fittings Average lux on road 250
Day (less than 20 000 lux)	30 400W SON/T Soffit fittings 50 2 x 5ft 65W cornice fittings Average lux on road 2 000	32 400W SON/T Soffit fittings 56 2 x 5ft 65W cornice fittings Average lux on road 2 000	32 250W SON/T Soffit fittings 56 2 x 5ft 65W cornice fittings Average lux on road 1 100	148 2 x 5ft 65W cornice fittings Average lux on road 250
Night	18 2 x 5ft 65W cornice fittings Average lux on road 80	20 2 x 5ft 65W cornice fittings Average lux on road 80	20 2 x 5ft 65W cornice fittings Average lux on road 80	74 2 x 5ft 65W cornice fittings Average lux on road 80

Table A

decorative incandescent lamps

by G E Coxon BSc PhD

Historical background

An examination of the catalogue of lamps and prices of the Edison and Swan United Electric Company of 1892 shows an astonishing range of carbon filament lamps which are highly decorative and serve particular purposes. This is all the more remarkable when it is remembered that the carbon filament lamp became a commercial possibility only in 1878 after Edison and Swan had turned their attention to this material.

Among the decorative or 'Fancy Lamps' as they are called which take the eye are lamps with hand-cut glass bulbs at 8s. each whose intricacy would infer that after filament failure the bulbs could be re-used. Candle lamps with conical crinkled and spiral form bulbs are described. Coloured lamps were sold with a wide range of natural coloured glass bulbs at extra cost (4s. clear, 6s. coloured).

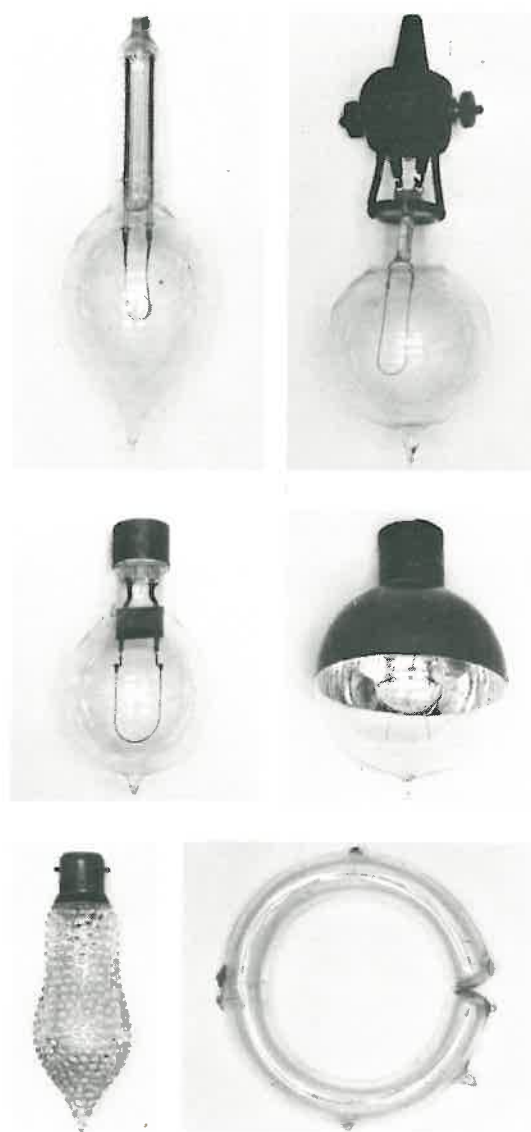
Many of the bulbs described are approximately spherical in shape. Undoubtedly this is the most convenient shape to blow by hand but it is also the strongest shape from the practical point of view when one remembers that these lamps enclose a high vacuum. Many of the decorative lamp bulbs of this period were designed to replace existing light sources such as rush lights, wax candles, oil lamps or gas mantles. One manufacturer of this period sold tubular, conical-ended lamps incorporating a carbon filament to replace candles (cost 5s. each). The company promised to pay the sum of 1s. 3d. for failed lamps, the object being to recover platinum from the lead-in wires.

Various materials, including tantalum, were tried as alternatives to carbon filament and between the two World Wars metal filament lamps using tungsten almost completely replaced carbon filament incandescent lamps; but recently the latter have reappeared in Europe as decorative lamps.

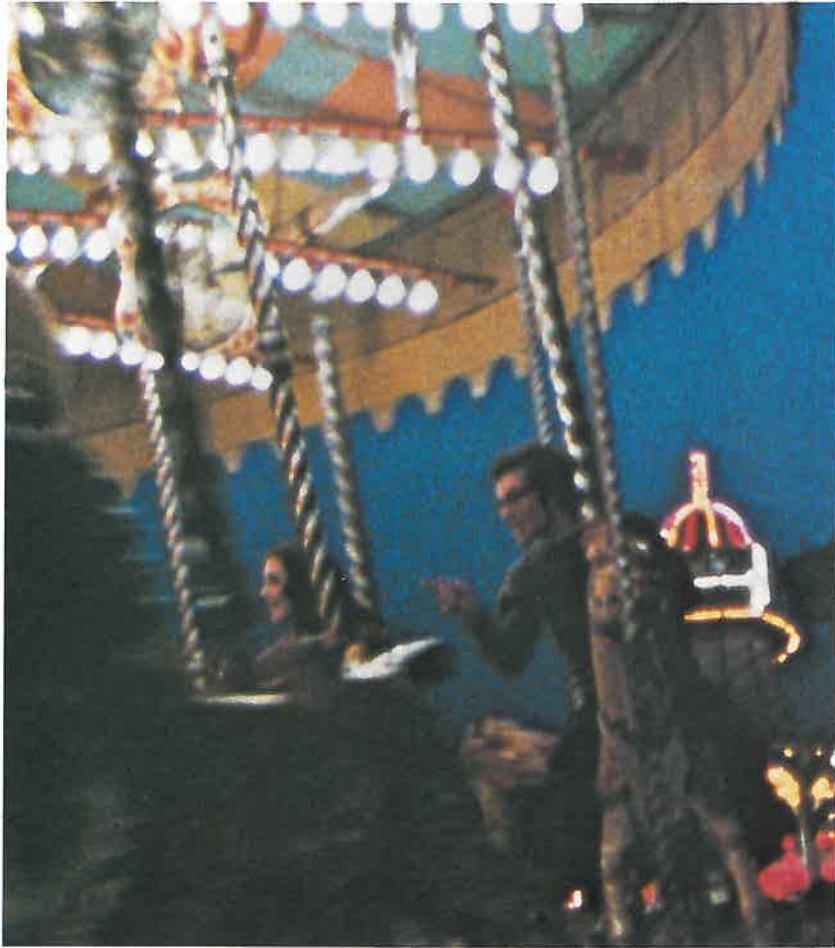
Linear incandescent source lamps also first appeared during this period and were used for architectural and display purposes. The linear tungsten coiled filament is suspended from a glass tube by metal supports running the length of the lamp. Electrical connection is made at either end or, in many cases, at a point at the side of the tube near to each end. Contact was originally made with the lampholders in this type by using a peg terminal on the lamp and a clip and locking device as holder which often gave trouble. The advantage of the side peg contacts is that a continuous strip of light can be produced, lamps being butted together. Curved lamps were also produced. The clear, linear 'Striplight' is often used today in showcases containing jewellery to provide the extra glitter lacking when a more diffuse source is used.

Modern decorative lamp developments

A resurgence of interest has arisen in the aesthetic appearance of lamps as well as in the quality and beam characteristics of the light produced. In some cases lamps have been designed with a coloured

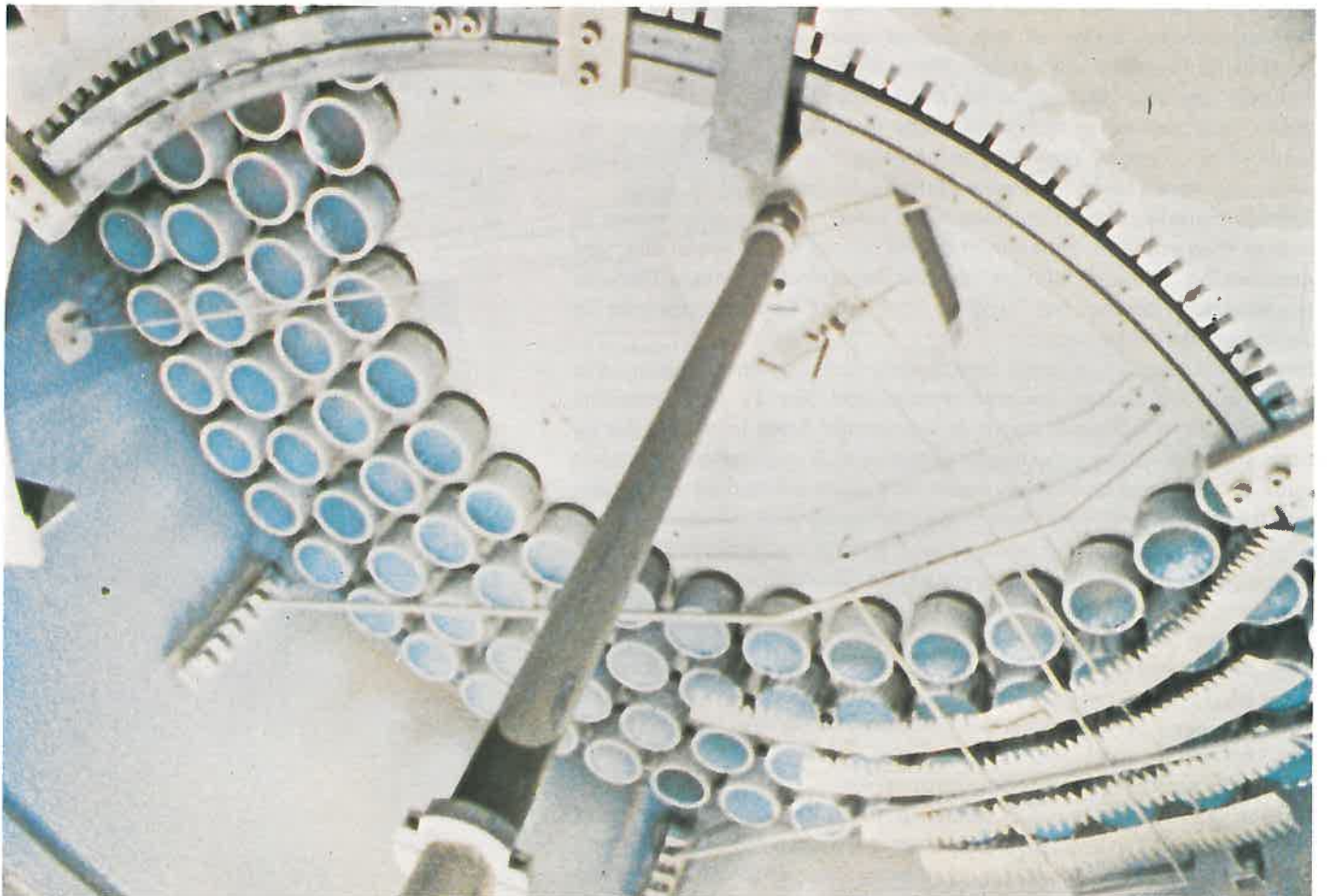


Some of the earliest carbon filament lamps from the Thorn collection.



Coloured lights are part of the fun of the fair.

Below: Material for coloured dichroic filters is deposited on the rotating front glasses of the lamps in this impressive machine.



finish which reduces the intensity of light. Lamps have been designed purely for their appearance and become an integral part of the design of the luminaire. These lamps are usually larger and more expensive but have a longer life than a standard lamp.

Bulb design

The renewed interest in these types has resulted in a fresh design approach with modern techniques of mass production in mind. For example, high-speed lamp manufacture requires that glass bulbs be positively located in sealing-in cradles so that the relationship between the bulb and the inner filament mount construction is fixed. This problem demands that the shape of the bulb, particularly the neck area, must allow positive location or special sealing-in cradles must be produced.

Two further points must be noted when a design is specified. The waste glass, or cullet, which falls away from the lamp after sealing-in, must do so under its own weight in high-speed production. A sufficient weight of waste glass must be left for this to occur. A further point is the necessity for accurate repetition of wall thickness on different bulbs travelling through a constant set of fires.

Decorative finishes

Modern techniques of high-speed production of glass bulbs for decorative purposes also place restrictions on the type of bulbs available. It is inconceivable that the economic production of natural coloured and textured glass bulbs can take place using these methods. Colours and textures must be applied to bulbs or finished lamps as an extra operation. A number of methods and materials have been developed which are employed in the modern production of decorative lamp types.

Coloured lamps are produced either by internal or external coating of the surface of the bulb with pigments. When the lamp is in use it is necessary to ensure that the heating effect of the colour coatings neither raises the bulb wall to temperatures which release impurities nor the cap region to unacceptable limits.

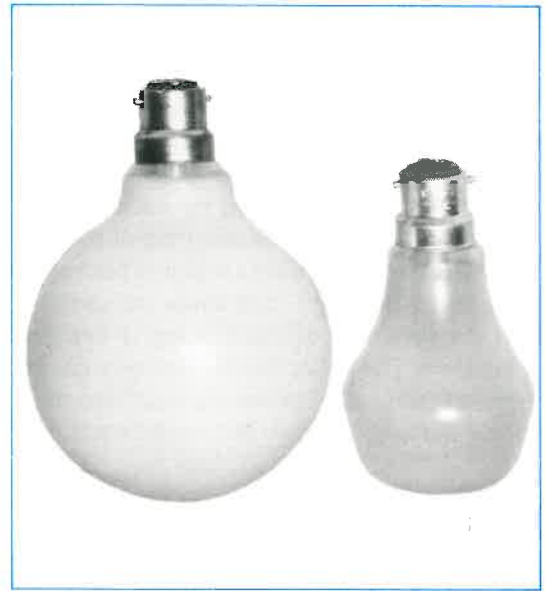
The methods of colour application available to the lamp designer can best be described by using particular examples of decorative lamps from the Mazda range.

Decor lamps

The Decor range consists of a number of large decorative lamps designed for an aesthetic as well as a functional purpose with an increased service life. The bulb shapes range from the angular doorknob shape through the slender cone bulb to the large round lamp.

All of these bulbs can be supplied with the Silverlight coating, giving an even white diffuse light, more efficient as a light producing unit than a combination of lamp and separate diffuser. This coating is applied as an aqueous suspension of freshly precipitated silica to the inside of the clear bulb. The coating is baked to remove the special binders and the bulb immediately transferred to a lamp-making unit. This type of suspension with the addition of a coloured pigment is used in the internal coating of low wattage lamps using standard pear-shaped bulbs and also in a wide range of small GLS lamps used in illuminated signs and as pilot lamps.

The Decor round lamp is also supplied in clear, red, green, purple and amber externally lacquered forms. The lacquers are special organic thermosetting paints which contain expensive pigments and resins which will withstand high temperatures in use (high temperature capability) but even so the rating is restricted to 40W for this large bulb. Automated spraying equipment with high temperature stoving facilities has been developed to produce these coatings on lamps of all shapes and sizes at high speed.



Mazda Decor round and Purlux lamps.

These lacquers must not only have high temperature stability through life but also have a sufficiently moderate curing temperature that does not affect lamp quality during processing, that is, the temperature in the oven must not exceed the normal running temperature of the lamp.

Coloured display lamps

The 75W and 40W coloured display lamps provide coloured light in a directional beam produced by placing the filament at the focal point of a paraboloid which is an integral part of the blown glass bulb. The interior is coated with a highly reflective material, usually vacuum-deposited aluminium, and since the atmosphere within the bulb is inert the condition of this coating is maintained throughout the life of the lamp. The colour is provided by a coating of slightly translucent coloured lacquer, of extremely high temperature capability, over the front of the lamp. Colours provided are red, green, blue and yellow.

Dichroic coatings

The problem of ultimate fading and peeling of organic coloured lacquers when applied to lamps which run unusually hot restricts their use to particular wattage ratings and bulb size combinations. Although organic lacquers can be safely used for the 100 watt lamp the 150 watt version is too hot for this technique to be employed.

One heat-resistant colouring process makes use of the selective optical properties of so-called dichroic coatings. This process has been applied to production of colour in the hard glass, long-life sealed beam display lamps, e.g. the 150 watt Color-ray PAR 38 lamps. The dichroic effect relies upon the interference produced by coating the internal surface of the lens with a series of alternate layers of two different transparent inorganic materials. Red, yellow, green and blue coloured display beams are produced. Multi-layer coatings can be laid down to transmit only the long wavelength (infra-red) radiation to reflect the wavelengths in the visible spectrum. Reflector coatings of this type are present in the Cool-ray 150W lamp. This technique is described more fully in *Lighting Journal* no. 8.

Crown silvered lamps

The modern trend of using incandescent lamps as an integral visual part of the lamp/fitting combination is well shown in the use of crown silvered lamps. Crown silvering is the vacuum coating of the interior crown of the bulb with a reflective layer of aluminium to a point on the bulb which just obscures the filament position. Light from the filament is reflected back through it from the inside crown and emerges through the lower half of the lamp. Such lamps are used in the silvered spotlight extensively employed for shop window illumination, the use of the half-silvered bulb with parabolic reflectors eliminating spill light in the beam. Another use is as part of large fittings providing frontal illumination from these lamps where the filament is obscured from view. In the former case colour can be produced by use of a coloured spun anodised aluminium reflector.

Conclusion

In conclusion, it can be said that this new trend of emphasising the design of decorative GLS incandescent lamps is to some extent reminiscent of similar usage in the early days of electric lamps. Illustrations showed that lamps were developed in the past as direct substitutes for existing primitive light sources and were meant to be used as decorations in their own right.

The use of modern designs, materials and techniques by lamp engineers has enabled new incandescent lamp types to be developed and to show that this basic method of lighting, now almost in its second century, has still something to offer in the face of the more efficient and sophisticated discharge sources in the field of decorative interior lighting.



Decor spot lamps

kite-marks and approval marks

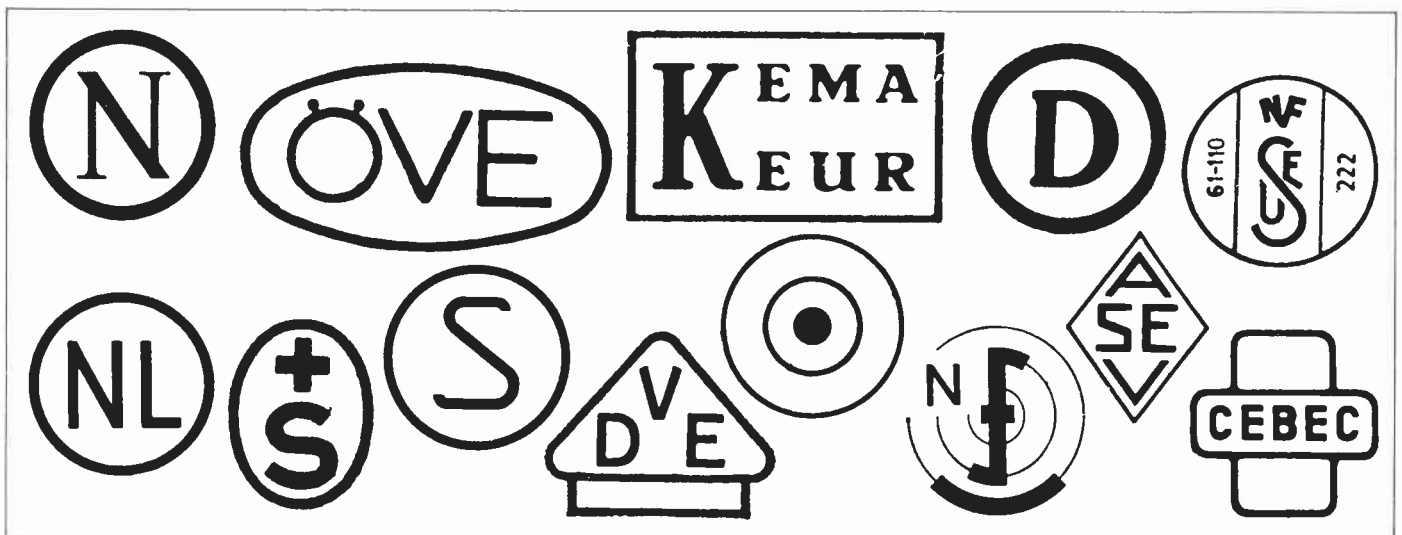
by R C Kember, C Eng BSc Eng (Hons) MIEE Millum ES, L H Da Volls
and J E Greenhill C Eng MIEE Millum ES

Most people are aware that official approval marks are widely employed on the continent and that in several countries the sale of electrical equipment without such a mark is forbidden. The use of such marks has obvious advantages since they signify that the goods conform with tests made at an independent testing station and that the standard is maintained by the manufacturer. They protect the consumer against unsatisfactory or unsafe products and the vendor from being held responsible for any harm resulting from their use. They also act as a trade barrier against unsatisfactory goods. With certain exceptions, the testing and marking of electrical goods in this country has been carried out on a voluntary basis, such organisations as the British Standards Institution having been set up jointly by Government, manufacturers and consumers to define standards and to regulate test procedures. There are, in fact, at least ten different approval marks currently in use in the United Kingdom, not only concerning electrical goods but such commodities as oil heaters and woollen goods. Three of the best known in the electrical field are the BSI Kite-mark, the BEAB mark used on consumer durables and the certificate of the British Approval Service for Electrical Equipment in Flammable Atmospheres (BASEEFA) which certifies compliance with the relevant British Standard and is mandatory in certain situations.

The low voltage directive

In February this year an important document entitled *The directive on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain limits* was issued by the Council of the European Communities at Brussels. Usually referred to as the Low Voltage Directive, it is designed to facilitate trade between member countries by harmonizing their safety regulations for electrical goods, since these differ considerably at present both in technical content and in the amount of freedom they allow for up-dating. As a first step to the removal of the barriers to trade caused by such differences it is proposed that member countries should recognise each other's marks or certificates of safety and that these should be published in the Official Journal of the European Community. The members should also harmonize their standards so that they should be recognised throughout the community. The

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directive consists of a preamble and 14 articles. The first of these limits the scope to 50 – 1 000V a.c. or 75 – 1 500V d.c. The next three articles require governments to legislate so that only safe goods may be placed on the market, that free movement of such goods is ensured, and that stricter requirements may not be imposed by electric supply authorities. Articles 5, 6 and 7 deal with harmonisation of standards and indicate preference for IEC or CEE published recommendations. Articles 8 and 9 cover problems associated with safe equipment, which does not fit the harmonised specifications, while articles 10 and 11 require mutual recognition of safety marks and certificates of safety. The remaining articles deal with administrative matters. Article 13, perhaps the most important, demands that member states “shall put in force the laws, regulations and administrative provisions necessary to comply with the requirements of the directive within eighteen months of its notification and shall forthwith inform the Commission thereof”. There are two appendices, one listing the safety objectives for equipment, and the other exemptions from the directive.

Legislation is being prepared by the Government, the result of which will be that all goods sold will have to comply with these requirements. Since British Standards on lighting equipment are in general harmonised with international specifications this means that the Kite-mark will rank among these, guaranteeing appropriate safety standards.

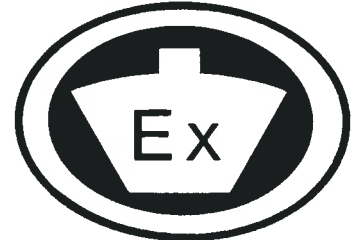
The BSI Kite-mark

The BSI has long led the world in setting safety and quality standards and its requirements are accepted by all reputable manufacturers. A new British Standard for Luminaires, BS 4533, has recently been issued and only luminaires that conform with it will be demanded by enlightened consumers in this country. This new standard, entitled *Specification for Electric Luminaires (Lighting Fittings)*, consists of a number of separate parts or books and uses other BS specifications as references for screw threads, lamps, ballasts, lampholders, etc. Conformity with this specification is the basis of the kite-mark system for luminaires and was promoted jointly by the Lighting Industries Federation and the BSI. The Kite-mark already has a very real significance to the professional user and to most manufacturers, and its value is beginning to be realised by the ordinary shopper. It is an independent assurance that the product on which it appears meets the requirements of the British Standard that defines its essential qualities. A manufacturer must be licensed by the BSI before the Kite-mark can be used and such licensing includes the assurance that adequate test facilities, up to the requirements of the BSI, are available to the manufacturer. A luminaire or other piece of equipment may be kite-marked only after it has passed rigorous testing in the BSI laboratories and after the laboratories have assured themselves that the manufacturer has the ability to produce a consistently acceptable product. The initial guarantee of safety and quality is maintained by sustained inspection of the factory by the BSI to check the manufacturer's quality control, to examine his records and to select random samples for full testing. A great deal of work must be done by designers, laboratory and factory staff to ensure that products conform. All this costs money – perhaps 1% of the product value—but it is worthwhile because of the confidence engendered in customers in products bearing this mark.

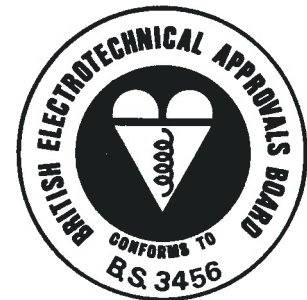
The increasing demand for luminaires bearing these approval marks and the consequent desire of leading manufacturers to conform has put a very heavy load on the BSI. It was decided by the LIF and the BSI that the first priority was domestic luminaires as these are often installed by non-professional people, thereby increasing the possible hazards. Thorn's first submission therefore included table and floor standards, wall-mounted luminaires and mirror lights, all of which



BSI Kite-mark



BASEEFA mark



BEAB mark

passed the appropriate tests. The examination of the complete range of commercial and industrial fluorescent, incandescent and discharge lamp luminaires by the BSI is now in progress.

Classification of mounting surfaces

The necessity to classify mounting surfaces has been recognised internationally and these are now likely to be divided into three groups: non-combustible, such as concrete or brick; normally flammable, such as wood planks or ceiling-board on wooden joists which have an ignition temperature of at least 200°C and will not deform or weaken at this temperature; and materials outside this range which are readily flammable and on which no luminaire should be directly mounted. New regulations are coming into force for the second category and it is likely that only in the case of ceilings made of non-combustible materials will close contact with the ballast be allowed. An interesting development which is being studied for international acceptance is the German "F" mark, designed to guard against the danger of the breakdown of a ballast at the end of life constituting a fire hazard. It is well known that towards the end of its life the insulation of a choke's windings may break down, resulting in a partial internal short circuit with consequent serious over-heating. All reputable manufacturers who conform with the British Standards ensure that the normal temperature of the parts of a luminaire which are in contact with the ceiling are well within the safety limits, but until recently the danger of fire due to the end-of-life conditions in ballasts had not been covered apart from the use of thermal cut-outs in some installations.

The German solution is so to design the luminaire that the surface on which it is mounted will not reach a dangerous temperature even when there are faulty components. This can be achieved by spacing the ballast away from the luminaire and the luminaire itself away from the ceiling or mounting surface.

In America a totally different approach is used so that thermal cut-outs come into operation when the temperature of the ballast rises above its normal level long enough to be dangerous.

The design of Thorn Lighting luminaires will progressively take these factors into account, so that mounting surfaces cannot reach a dangerous temperature even under faulty conditions. In the interim, a cut-out device has been developed so that even luminaires which do not fully comply with these requirements can be protected, as for example those which have been installed for a number of years. Bearing in mind that the normal rated life of a ballast in continuous operation is ten years and that fluorescent lighting has now been with us for over thirty years it is reasonable to expect that since a ten-hour working day is typical the rate of failure of ballasts will accelerate in the future. Fortunately, the vast majority of ballasts end their life with no dangerous consequences, either by blowing a fuse or by going open circuit. Nevertheless, where it is felt that there is need to increase safety margins in existing installations spacers and/or cut-outs may be applied.

Conclusion

A great deal of work is being done, in which Thorn Lighting plays its part, to encourage the harmonisation of national standards with the object of producing truly international ones. The immediate aim, which has already reached an advanced state, is to achieve completely unified standards in Europe leading to the adoption of a single European approval mark instead of the present national ones, and it is hoped that once this has been achieved the process will spread until a world-wide system is established. Such standards can do nothing but good, simplifying manufacture and marketing and hence encouraging world trade. The United Kingdom has long had a tradition of voluntary acceptance of standards and we have much to offer our new partners in the Common Market.



German 'F' mark

metal halide lamps for colour printing

by A L Salway MSc(Eng) and E J G Beeson MllumES MBK&TS

Even the most casual reader of the printed page must have noticed the increasing use of colour printing. Newspapers nowadays regularly carry coloured advertisements; magazines and catalogues rely on accurate colour reproduction for their effects. Colour printing, in fact, is big business.

The preparation and printing of colour features is a complicated process, beyond the scope of a short article such as this, but briefly it consists of taking a photographic negative of the required subject matter and then placing it in contact with a specially coated metal plate in a printing-down frame. This frame consists of a table top covered by a glass sheet, the negative and plate being kept in close contact by a vacuum introduced between the table top and the glass plate. The combination is irradiated by ultra-violet (u.v.) and the plate is then developed in appropriate chemicals which have the effect of etching those parts obscured by the dark parts of the negative during exposure.

Traditionally the source of ultra-violet has been the carbon arc. The main criterion for the lamp was the provision of ultra-violet of appropriate wavelength, particularly in the near visible u.v. range, to match the coating material of the plate. The carbon arc is not ideal: it is messy, not particularly stable, requires constant attention, and its running costs are by no means negligible. From time to time other sources have been used, such as high pressure mercury and pulsed xenon lamps, each of which has its merits, but the xenon lamp is expensive in the control gear necessary to run it.

Most sensitive plates and sensitised coatings depend upon energy emitted in the ultra-violet region and are comparatively insensitive to other frequencies so that they can be used in subdued daylight or in an artificially lit room. Light sources used for photo-printing must therefore provide the greatest possible output in the spectral sensitivity band of the materials being exposed in order to keep exposures reasonably short.

Requirements of the light source

To compare and appraise different light sources the following considerations must be taken into account:

- Most of the radiated energy must fall into or match the spectral sensitivity of the material;
- The lamp should preferably be able to be switched on or off to make an exposure;
- In most instances the light should be a point source. This gives a sharp image and prevents undercutting (Figure 1) which can occur where a number of light sources are 'banked' to give even illumination. In some letterpress processes a large diffuse source is desirable;

A L Salway is Product Executive for Hytek Lamps and E J G Beeson Manager of Special Lamp Development at Thorn Lighting, Leicester.

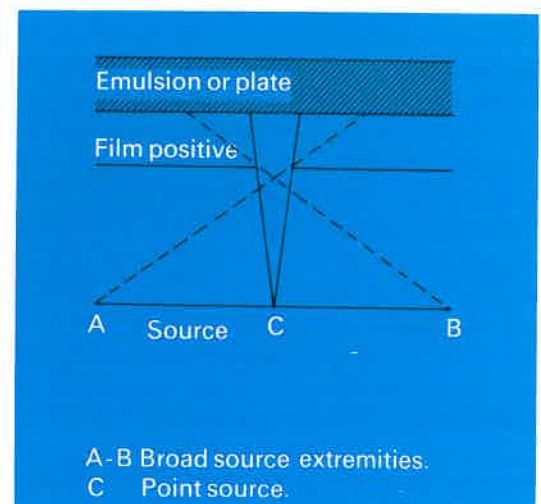


Figure 1

Degree of undercutting comparison for broad and point sources.

- d) The lamp ideally should not emit erythema-producing radiation or generate any toxic ozone ;
- e) Lamp life should be reasonably long and compatible with the economics of the process ;
- f) The infra-red content given by the light source should be minimal to prevent absorption and expansion of photographic materials particularly when these have to be brought into register with colour processes.

Types of light source

The carbon arc and the mercury vapour lamp are already being rapidly replaced by other discharge sources for a number of reasons :

- a) Higher actinic sources have been developed which are more selective in their radiated output ;
- b) Some discharge sources, although less actinic, can be switched on and off to make an exposure ;
- c) More powerful lamps approaching a point source to simulate the carbon arc offer cleanliness in operation as well as speed.

Lamps used in colour printing cover a wide area of application and are used not only in reprographic plate making but also for etch resists, letterpress, colour proofing, diazo, carbon tissue and other materials which are sensitive in the longer wave ultra-violet from 320nm to 460nm. (A nanometer is a wavelength of one millionth (10^{-6}) of a millimetre). The fluorescent tube is widely used for photocopying, particularly in producing the final copy, and has the advantage of producing pure u.v. almost without heat. It has however a low total output and a number must be used with the consequent problem of light undercutting. The pulsed xenon lamp, because it can be switched on and off has been developed in high powers ; it has been applied to many processes and is excellent for colour work since its spectrum is well balanced and constant in colour quality.

Some years ago Thorn introduced the Kolorarc lamp in which, by adding metal iodides and other halides as well as mercury to the arc tube, it was possible considerably to improve the colour quality of the lamp. This gave Thorn Lighting's Leicester development engineers the opportunity of taking a look at the possibility of developing a u.v. source for photoprinting purposes. By varying the additives within the arc tube, a technique was developed to produce sources with peak energy in the 400/420nm region.

A linear 1200W MBIL lamp was first introduced and tests were arranged in conjunction with equipment manufacturers and users. Results were more than promising. Agfa Gevaert, producers of coating materials known as Gevaproof, found the lamp so satisfactory that they now recommend the use of the Thorn 1200W MBIL in their Gevaproof process. A number of large printers, particularly in the Leeds area, have also converted their equipment from carbon arcs to the 1200W MBIL lamp.

Although highly successful, the 1200W MBIL lamp is not ideal for all circumstances. For the small printing frame it is too big, and it is far from a point source so that undercutting may result. Further, in conversion of old equipment the user had to tailor-make his own reflectors to suit his particular circumstances. It was therefore decided to introduce a 400W version of the lamp enclosed in a sealed beam envelope of similar size to the 1kW CSI sealed beam stadium lighting lamp.

By enclosing the metal halide lamp arc tube in a sealed beam reflector with a front refractor a unique ultra-violet lamp is produced (Figure 2) which offers a number of advantages. As the internally

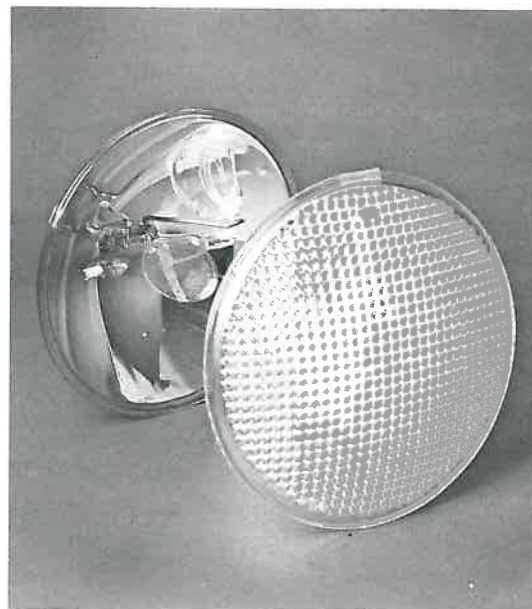


Figure 2 MBI PAR 64 with front glass removed to show arc tube.

aluminised reflector is enclosed in an inert atmosphere no deterioration of its surface occurs; the lamp is accurately pre-focused in its reflector which, with the refractor, produces an elliptical beam to give a high degree of uniformity over rectangular printing frames. The hard-glass outer envelope filters out any erythema-producing radiation and no toxic ozone is generated. It is possible to produce reasonably uniform radiation over a rectangular area 24in x 20in, which is an average size smaller printing frame, with the lamp suspended at approximately 30in from the frame. The lamp is designed to operate at 400 watts from a commercial ballast with a starting aid from normal 240V a.c. supplies and takes less than three amps. The run-up time from switch-on is under two minutes and restrike time, dependent on the amount of ventilation, is around 7-10 minutes. Some of the more important lamp and circuit characteristics are summarised in Table 1.

Results have been more than satisfactory and show an average increase in printing speeds – watt for watt – of some eight times when compared with other lamp sources. A number of equipment manufacturers are introducing the lamp into their new designs. The first is Torr of Silverstone who already market printing-down frames incorporating either single or twin 400W sealed beam units (Figure 3).

Supply voltage	220–240V
Lamp watts	400W
Arc volts	105V
Arc current	4.4A
Supply p.f.	0.9 p.f. (240V)
Supply current	2.2A
Diameter	205mm (8in)
Overall depth	110mm (4.375in)
Run up time	1½–2 min
Re-strike time	7–10 min (dependent on ventilation)
Life	1 000 hours nominal
Operating position	Any, provided arc tube is horizontal

Table 1 Lamp and circuit characteristics.



Figure 3

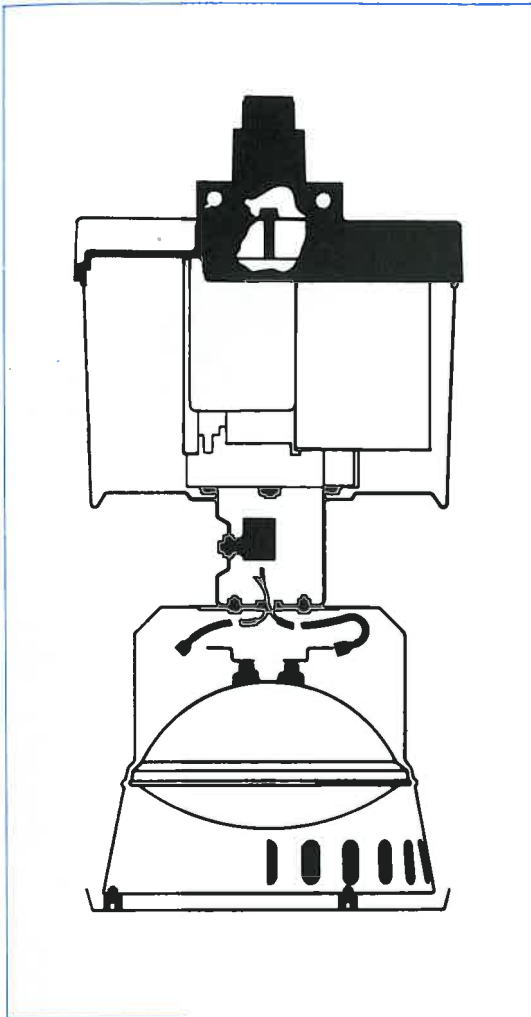


Figure 4



Figure 5

A number of printers both large and small use printing-down frames operated from separately mounted carbon arc lamps. To make simple conversions of these machines it is necessary to provide a complete package deal which can be offered as a single replacement to the carbon arc.

Existing frames where the light-source is accommodated in the base can easily be converted to take this lamp. For bench-top types the Graph-X fitting, a simple suspended unit comprising a control gear and starter compartment and a lamp housing with a magnetically held shutter lid, offers ready conversion (Figures 4 and 5).

The results obtained from practical experience in a number of rapidly growing applications are summarised in Table 2.

Conclusion

The Graph-X lamp not only provides a source for the major printing processes but is also meeting the requirements of the smaller printer. This application of u.v. for printing processes is indicative of the growing interest in u.v. sources for wider fields which is engaging the attention of Thorn Lighting's Research and Development Laboratories.

Material	Light source	Exposure time	Gain
Ammonium bichromate emulsion (Deep etch)	45 amp carbon arc (approx 2½ kW)	8 min	
	400W Graph X	9 min	5X
Silk Screen	50 amp carbon arc (approx 2½ kW)	6 min	
	400W Graph-X	5 min	7½X
Diazo coated aluminium	1 kW mercury	4 min	
	400W Graph-X	1.25 min	8X
Photo-resists	500W mercury	25 min	
	400W Graph-X	3 min	10X

Table 2

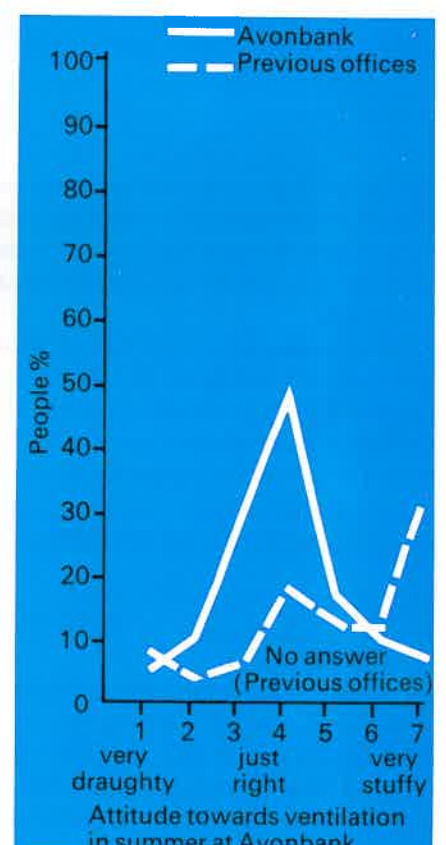
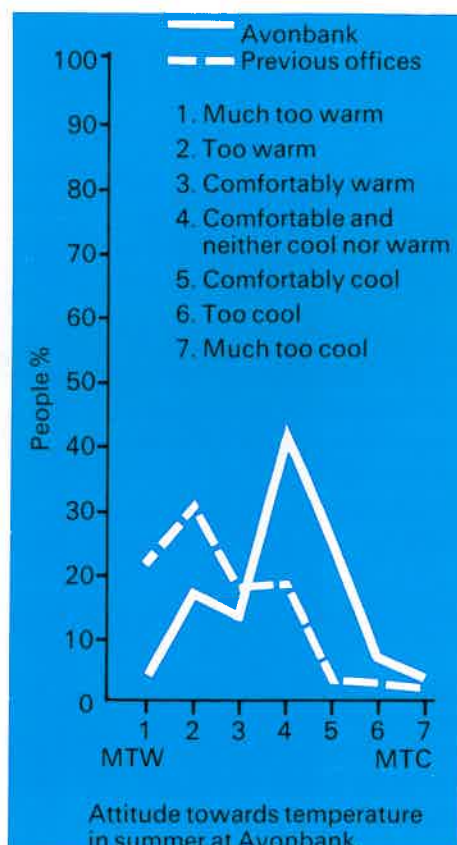
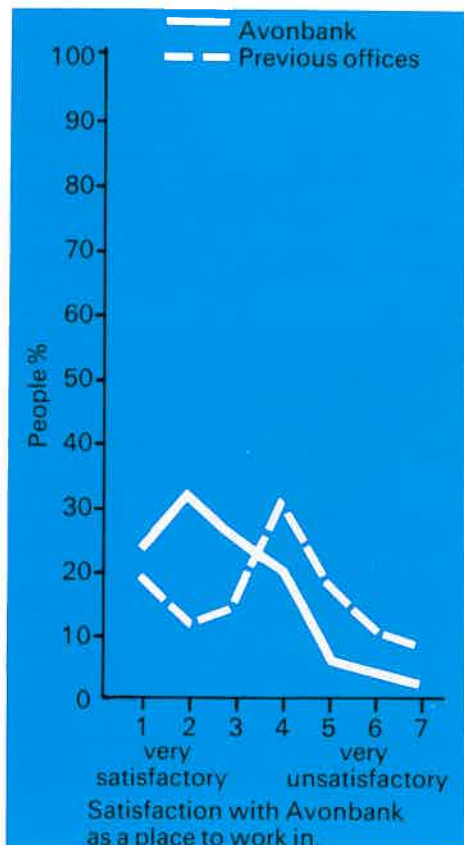
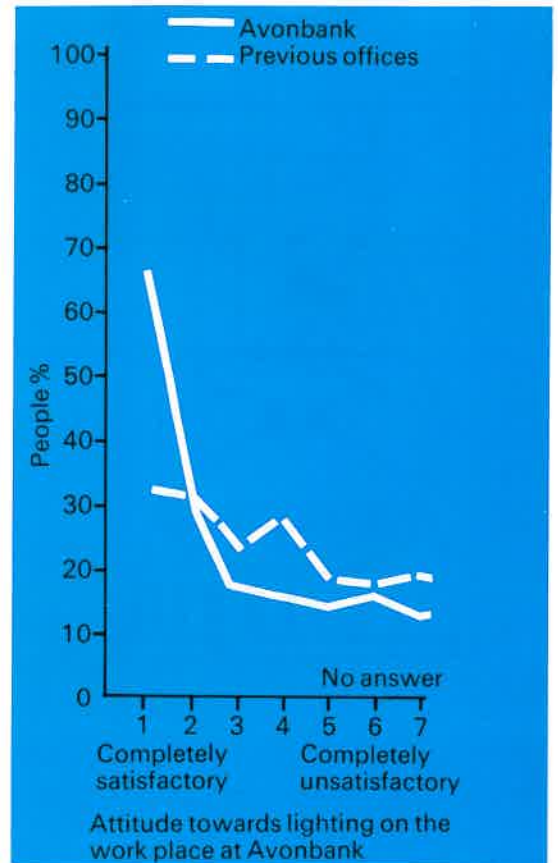
avonbank - a footnote

from Lighting Research and Technology volume 5, no. 2 1973

The controlled environment at Avonbank, the South Western Electricity Board's offices at Bristol, was described in *Lighting Journal* no. 7. The offices have now been in use for over two years and were the subject of a paper read to a joint meeting of the IES and the Building Services Engineering Society by Ian Crichton and Mark Wood-Robinson last November.

One of the most interesting points that came out was the reaction of people working in the Avonbank offices to the new conditions. Most of these people had previously been working in smaller conventional offices throughout Bristol, and, knowing that they were to be moved to Avonbank, the SWEB made a survey of their attitudes towards various environmental factors at their places of work before they moved. The same questionnaire was put to them three or four months after moving to Avonbank. Some of the results are shown here. They speak for themselves, although Mr Wood-Robinson remarks that you can never expect to please all of the people all of the time.

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FOR INDUSTRY 1968
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